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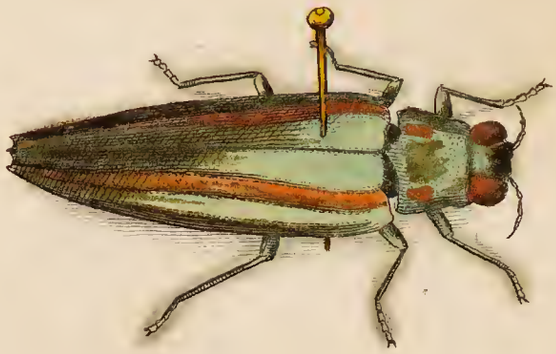

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The NATURALIST'S, and TRAVELLER'S COMPANION,

Containing

Instructions for collecting & Preserving Objects of

NATURAL HISTORY,

and

for promoting inquiries after Human Knowledge in General.

the Second Edition corrected & Enlarged.

BY John Coakley Lettsom M.D. F.R.S. & S.A.

LONDON. Printed for E. & C. Dilly. 1774.

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TO THE GREAT

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THE FOLLOWING

TREATISE

IS,

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THE AUTHOR.

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THE

PREFACE.

"HE that enlarges his curioſity after the works of nature," ſays a celebrated writer, "demonſtrably multiplies the inlets to happineſs. A man that has formed a habit of turning every new object to his entertainment, finds in theſe productions an inexhauſtible ſtock of materials upon which he can employ himſelf, without any temptations to envy or malevolence; faults, perhaps, ſeldom totally avoided by thoſe, whoſe judgment is much exerciſed upon the works of art. He has always a certain proſpect of diſcovering new reaſons for adoring the ſovereign author of the univerſe, and probable hopes of making ſome diſcovery of benefit to others, or of profit to himſelf."

No method appears better calculated to enlarge our knowledge of Natural Hiſtory, than viſiting foreign countries, and carefully attending to the different objects they afford, which more or leſs delight by their novelty and variety; but our inquiries ſhould not be confined merely to private gratification; there are duties of a more rational nature; to be uſeful to

ſociety by diſtributing happineſs amongſt our fellow creatures, is one of the higheſt and moſt neceſſary. The numerous products of nature, their application to the wants, the comforts and even ornaments of life; the manners, cuſtoms and opinions of mankind; agriculture, manufactures, and commerce; the ſtate of arts, learning, and the laws of different nations, when judiciouſly inveſtigated, tend to enlarge the human underſtanding, and to render individuals wiſer, better and happier.

The introduction of the common potatoe, the management of ſilk-worms, the diſcovery of jeſuits bark, the uſes of cochineal, Lacca and Indigo, are undeniable proofs of the advantages which might be derived from the inquiries of ingenious men. The diſcovery of another ſuch root as the potatoe, another ſuch article of commerce and apparel as ſilk, another ſuch remedy as the bark, and ſuch other dyeing articles as cochineal and indigo, would prove acquiſitions of the greateſt importance to a trading nation, and render the iniquiſitive traveller conſpicuous as a public bleſſing.

Many gentlemen and ſea-faring perſons who go abroad, by their office and ſituation in life, enjoy both time and opportunity for collecting the beſt information

on ſuch ſubjects of general utility, eſpecially the natural productions peculiar to the place they viſit or reſide in, which they are induced to overlook for want of proper directions for diſtinguiſhing and preſerving them, whereby things of value and uſe are loſt to the public, and the time of the traveller leſs beneficially employed.

To promote an application of the time and talents of ſuch perſons to rational and commendable inquiries of this kind, is the deſign of the following directions, which the author thinks himſelf juſtified in recommending, as they principally reſult from experiment and obſervation: Theſe were firſt publiſhed about twelve months ago, and the reception from the public hath been ſuch, as renders another edition requiſite, while it intimates the utility of the original plan, which has ſince been conſiderably improved, to make it more deſerving of future encouragement.

The ſecond part is intirely new, in which are introduced ſeveral queries and obſervations on natural hiſtory, and upon ſubjects in general, which have not been clearly and ſufficiently aſcertained, and therefore merit the attention of the Naturaliſt and Traveller. For this part of his publication, the author acknowledges himſelf

ſelf principally indebted to the ingenious John Reinhold Forſter, who obligingly preſented to him many of his manuſcript papers, previous to his departure on the preſent expedition to the South Seas. He has alſo the pleaſure to mention his obligation to the celebrated Linnæus, and other correſpondents, who have favored him with their obſervations on different ſubjects of natural hiſtory.

Several treatiſes however have been written on the plan of the firſt part; ſome years ſince, M. Turgot publiſhed his "Memoire inſtructif ſur la Maniere de raſſembler, de preparer, de conſerver, et envoyer les diverſes Curioſités d'Hiſtoire Naturelle, Lyons, 1751. 8vo." with figures; but the directions it contains are prolix, and in many reſpects injudicious; ſo ignorant is the author of a proper method of preſerving inſects, that he directs the collector to place them betwixt leaves of paper (pag. 88.) ſimilar to the recommendation of Petiver.

In the "Amoenitates Academicæ," publiſhed in 1753. under the ſanction of the great Linnæus, Dr. Hultman gives his Inſtructio Muſei Rerum Naturalium in a very intelligent manner, though in a language which renders this ingenious production of leſs general utility.

My

My friend John Reinhold Forſter wrote his directions for collecting, preſerving and tranſporting all kinds of natural hiſtory curioſities, in 1771. This performance, though a work of merit, is too conciſe for the purpoſe deſigned; and the author's method of preſerving birds is not juſtified by experiment, as it will neither ſecure ſuch ſubjects from inſects, nor admit of their receiving a natural poſition.

Other writers have alſo appeared in different departments of Natural Hiſtory, the principal of which will be noticed under the particular heads they treat upon.

If perſons who go abroad, or reſide in foreign countries, were acquainted with mathematics and drawing, they would in all probability make their remarks more acceptable, by adding accurate maps of the countries they viſit or reſide in; and by joining to them the drawings of men, their dreſſes, utenſils, weapons, coins, machines, rites, ſacrifices, buildings, temples, idols, and antiquities; as well as the curious quadrupeds, birds, reptiles, fiſh, inſects, and ſhells peculiar to each place; with the plants found in thoſe climates, eſpecially ſuch as are employed for food, in commerce, manufactures, phyſic, dyeing and other purpoſes.

In the drawings and deſcriptions relative to natural hiſtory, it is neceſſary

to

to attend to many circumſtances which are the characteriſtics of each ſpecies of the animal and vegetable creation. In quadrupeds the number and diſpoſition of the teeth; ſhape and poſition of the horns; number of the toes in each foot; ſhape and ſize of the claws and hoofs; ſize of the ears; color and diſpoſition of the whiſkers; nature and growth of the hair in the fur, mane and tail; length and uſes of the tail; whether calculated to graſp any object, or to give the animal ſtability; and even the attitude which is characteriſtic of the animal, and ſhews beſt its marks, ſpots, ſtripes, claws, ears, tail, &c. ought to be expreſſed.

In birds, the ſhape and uſes of the bill, whether notched, ſerrated, or otherwiſe remarkable; number and diſpoſition of the toes, and whether diſtinct, lobated, or palmated; length of the legs and nakedneſs of the knees; color of the greater and ſmaller quill feathers, upper and under coverts of the wings; number and color of the tail feathers, and coverts of the tail; appearance of the vent, belly, breaſt, throat, back, creſt, wattles, carunculæ, ſpurs, &c; attitude peculiar to the bird, and the difference between males and females, and young and old birds, ſhould be deſcribed.

In tortoiſes or turtles the diſpoſition of the ſhell, and its compartments; ſhape and number of its toes; abſence or preſence of the tail, and ſhape of the head, muſt be delineated.

In ſnakes, the ſcales above and below, their number, color, and figure; form of their heads, and whether they are venomous, ſhould be remarked.

In fiſh, it is neceſſary to attend to the proportion of the breadth to the length; form of the head and diſpoſition of the palate and teeth; ſhape and poſition of the mouth; ſize and ſituation of the eyes; coverts of the gill, and rays of its under-part; ſpines, horns, and protuberances of the head; number, figure, ſize and color of the fins and tail, with the ſpinoſe and ſoft rays in each; the turn of the lateral line, with the form, color and diſpoſition of the ſcales.

In inſects, the ſeaſon when each of the different kinds appear ſhould be obſerved; the number, ſubſtance, and particular ſhape of their wings, with the poſition of them when the inſect is at reſt; the ſhape of the antennæ or horns, with the number of joints in each; the form of the head, mouth and eyes, more particularly of the head in beetles, of the mouth in bees, waſps, flies and gnats, and of the eyes in ſpiders; the number and ſize of the legs;

the

the ſhape of the thighs, feet and claws; the ſtings peculiar to the hymenoptera claſs, and the uſes they are applied to: but the natural hiſtory of inſects ſhould in a peculiar manner engage the traveller's attention, as it is of more conſequence to diſcover the natural hiſtory of one deſtructive or uſeful inſect, than merely to collect and bring over twenty in their perfect ſtate; the former, at the ſame time that it makes the ſcience more entertaining, bids fair to benefit mankind, while the latter ſerves only to fill the cabinets of the curious; he ſhould therefore carefully obſerve the manner in which inſects copulate, and the places where they depoſit their eggs; what food the young larvæ or caterpillars feed upon; if vegetable, whether it be the root, trunk, leaf, flower or fruit; if deſtructive, as they moſtly are, the methods uſed by the natives to deſtroy them; and if uſeful, the means of cultivating them; and what are their natural enemies; the form, attitude and markings of the caterpillar, ſhould be deſcribed; if it has feet, their number, and the particular rings on which they are ſituated; whether it be ſmooth, hairy or ſpinous, and the manner of its changing into the chryſalis or pupa ſtate, and how long it continues before it arrives to perfection, with the various inſtincts and

con-

contrivances they have for avoiding dangers and catching their prey.

In ſhells, not to neglect the number of them belonging to one animal; when ſingle, the turn in the windings, whether to the right or left; the ſtripes, ſpots, bands, knobs, ſpines, furrows and other marks; ſhape of the mouth or opening of the ſhell, lips and beaks: In thoſe that have two or more valves, their equal or different ſizes; the form of the hinges where they are connected, and the number of indentures tallying together; the ſtripes and furrows on the outſides, and whether longitudinal or tranſverſal; and the animals inhabiting the ſhells ſhould likewiſe be obſerved and delineated.

In the reſt of the worm tribe, the ſhape, arms, and other parts of the animal ſhould be delineated.

In plants the greateſt accuracy is requiſite, the ſhape of the flower being ſo varied, nice attention is neceſſary to diſtinguiſh its minute parts; the figure and number of the flower leaves; the form and ſections of the flower-cup; the number and diſpoſition of the duſt veſſels, and of the columnar veſſels ſtanding on the fructification (which are reckoned by botaniſts to be the male and female parts of the flower, and in ſome inſtances are on different plants; in others on the ſame plant,

plant, but in different parts of it); the ſhape, ſtructure, and color of the ſtalk and leaves; the appearance and ſtructure of the roots, and ſuch other circumſtances as characterize the different ſpecies of plants, ought never to be omitted.

The Naturaliſt ſhould likewiſe endeavour to keep an accurate journal, wherein all the occurrences, obſervations, places, diſtances, deſcriptions, accounts, informations, and remarks, ſhould regularly and daily be entered, while recent in memory.

THE

THE NATURALIST'S AND TRAVELLER'S COMPANION.

PART the Firſt.

SECT. I.

The Method of catching and preſerving INSECTS *for Collections.*

——Ten thouſand different tribes
People the blaze. To ſunny waters ſome
By fatal inſtinct fly.
——Through the green-wood glade
Some love to ſtray; there lodg'd, amus'd and fed,
In the freſh leaf. Luxurious, others make
The meads their choice, and viſit every flower,
And every latent herb. (*a*)

INSECTS in general are known to moſt people, the ſyſtematic diſtinctions but to few; nor have we any Engliſh names for the greateſt part of them. The general denomination of beetles, butterflies, moths, flies, bees,

(*a*) Thomſon's Seaſons, Summer, l. 246.

waſps, and a few other common names, are all that our language ſupplies. It would, therefore, be in vain to enumerate the immenſe variety of genera and ſpecies to any perſon unſkilled in the ſcience of entomology: we may, however, give directions under general names, where to find and how to catch each kind. (*b*)

I. The Coleoptera (*c*), or firſt great claſs of inſects, including beetles, are found in and under the dung (*d*) of animals, eſpecially of cows, horſes, and ſheep: many of them make holes under the dung three or four inches deep; it will therefore be neceſſary to have an iron ſpade to dig them out, when in ſearch of this tribe of inſects.

Some (*e*) are found in rotten and half decayed wood, and under the decayed bark of trees; on the carcaſes (*f*) of animals that have been dead four or five days; on moiſt bones that have been gnawed by dogs or other animals; on flowers having a fœtid ſmell; and on ſeveral kinds of fungous ſubſtances, particularly the rotten

(*b*) Vide Schoeffer. Elementa Entomologica. Curtis's accurate inſtructions for collecting and preſerving inſects, and his introduction to the knowledge of inſects, tranſlated from the Fundamenta Entomologiæ of Linnæus. Amæn. Acad. v. 7.

(*c*) Coleoptera, from κολεὸς, a ſheath, and πτερον, a wing, are ſuch inſects as have cruſtaceous Elytra, or ſhells, which ſhut together, and form a longitudinal ſuture down the back of the inſect, as the beetle, Bupreſtris ignita, fig. 1.

(*d*) Scarabæus, *chafer*. Dermeſtes, *leather-eater*. Hiſter, *mimick-beetle*. Staphylinus, *rove-beetle*. (*e*) Lucanus, *ſtag-beetle*. Cerambyx, *capricorn-beetle*. Dermeſtes. (*f*) Hiſter. Silpha, *carrion-beetle*. Staphylinus.

(*g*) Byrrhus,

rotten and moſt ſtinking: others (*g*) may be found in a morning about the bottoms of perpendicular rocks and ſand banks, and alſo upon the flowers of trees and herbaceous plants.

Many kinds (*h*) may be caught in rivers, lakes, and ſtanding pools, by means of a thread net, with ſmall meſhes, on a round wire hoop, fixed at the end of a long pole.

In the middle of the day, when the ſun ſhines hot, ſome (*i*) are to be ſeen on plants and flowers, blighted trees and ſhrubs; others (*k*) in moiſt meadows are beſt diſcovered at night, by the ſhining light which they emit.

A great variety (*l*) ſit cloſe on the leaves of plants, particularly of the burdock, elecampane, coltsfoot, dock, thiſtle, and the like; or feed on different kinds of tender herbs (*m*).

Numbers (*n*) may be found in houſes, dark cellars, damp pits, caves, and ſubterraneous paſſages, or on umbelliferous flowers (*o*), on the trunks as well as the leaves of trees; in timber-yards, and in the holes of decayed wood.

Some (*p*) inhabit wild commons, the margins of pools, marſhes, and rivulets; and are likewiſe ſeen creeping on flags, reeds, and all kinds of water-plants.

Multitudes (*q*) live under ſtones, moſs, rubbiſh, and wrecks near the ſhores of lakes

(*g*) Byrrhus, curculio, *weevil*. Bruchus, *ſeed-beetle*. (*h*) Gyrinus, *whirl-beetle*. Dytiſcus, *water-beetle*. (*i*) Coccinella, *lady-fly*. Bupreſtis, *burn-cow*. Chryſomela, *golden-honey-beetle*. Cantharis, *ſoft-winged-beetle*. Elater, *ſpring-beetle*. Necydalis, *clipt-winged-beetle*. (*k*) Lampyris, *glow-worm*. (*l*) Caſſida, *tortoiſe-beetle*. (*m*) Meloë, *bliſter-beetle*. (*n*) Tenebrio, *ſtinking-beetle*. (*o*) Cerambyx, Ptinus. (*p*) Leptura, *wood-beetle*. Cicindela, *gloſſy-beetle*. (*q*) Carabus, *ground-beetle*.

and rivers. Theſe are found alſo in bogs, marſhes, moiſt places, pits, and holes of the earth, on ſtems of trees; and in an evening they crawl plentifully along path-ways after a ſhower of rain.

Some (*r*) may be diſcovered in the hollow ſtems of decayed umbelliferous plants, and on many ſorts of flowers and fruits.

II. Another claſs (*s*) of inſects are found about (*t*) bake-houſes, corn-mills, in ſhips, and in all places where meal is kept; on graſs (*u*), and all kinds of field herbage. Some (*v*) of theſe frequent rivers, lakes, and ſtanding-pools.

III. Butterflies and moths make another great diviſion (*w*). In the day, when the ſun is warm, butterflies (*x*) are ſeen on many ſorts of trees, ſhrubs, plants, and flowers. Moths (*y*) may be ſeen in the day-time, ſitting on walls, pales, trunks of trees, in ſhades, out-houſes, dry holes, and crevices; on fine evenings they fly about the places they inhabit in the day-time: ſome (*z*) are ſeen flying in the day-time over the flowers of honey-ſuckles and other

(*r*) Forficula, *earwig*.

(*s*) Hemiptera, from ἡμισυ, half, and πτερον, a wing, have their upper wings uſually half cruſtaceous, and half membranaceous, not divided by a longitudinal ſuture, but incumbent on each other, as the Cimex, fig. 2. (*t*) Blatta, *cockroach*. (*u*) Mantis, *camel-cricket*. Gryllus, *locuſt*. Fulgora, cicada, *flea-locuſt*. Cimex, *bug*. (*v*) Notonecta, *boat-fly*. Nepa, *water-ſcorpion*.

(*w*) Lepidoptera, from λεπις, a ſcale, and πτερον, a wing, are inſects having four wings, covered with fine ſcales in the form of powder or meal, as in the butterfly, Papilio Antiopa, fig. 3. (*x*) Papilio, *butterfly*. (*y*) Phalæna, *moth*. (*z*) Sphinx, *hawk-moth*.

plants

plants with tubular flowers. Inſects of this ſpecies ſeldom ſit to feed, but continue vibrating on the wing, while they thruſt the tongue or proboſcis into the flowers.

IV. Inſects of this claſs (*a*) are found in woods (*b*), hedges, meadows, ſand-banks, walls, pales, fruits, and umbelliferous flowers; ſome (*c*) fly about lakes and rivers in the day.

V. The fifth diviſion (*d*) including waſps (*e*), bees, (*f*), *&c.* may be ſeen about hedges (*g*), ſhrubs, flowers, and fruits. Waſps and bees are the only winged inſects that have any great degree of poiſon in them; they ſhould therefore be taken with a pair of forceps, and handled cautiouſly on account of their ſtings, which are dangerous. Some (*h*) of this diviſion have ſtings, but no poiſon, and are to be found on the flowers of umbelliferous plants, when the ſun ſhines hot in the middle of the day; at which time others (*i*) are ſeen on ſand-banks, walls, and pales.

VI. Flies of various kinds conſtitute the next claſs (*k*); they fly about the tops of trees (*l*),

(*a*) Neuroptera, from νεῦρον, a nerve, and πτερον, a wing, have four membraneous tranſparent naked wings, generally like network, as in the Panorpa Coa, fig. 4. (*b*) Myrmeleon, hemerobius, *pearl-fly*. Raphidia, *camel-fly*. (*c*) Libellula, *dragon-fly*. Ephemera, *may-fly*. Phryganea, *ſpring-fly*.

(*d*) Hymenoptera, from υμὴν a membrane, and πτερον a wing. Inſects with four membraneous wings, tail furniſhed with a ſting; as in the Tenthredo, fig. 5. (*e*) Veſpa, *waſp*. (*f*) Apis, *bee*. (*g*) Tenthredo, *ſaw-fly*. Sirex, *tailed-waſp*. Ichneumon, *ichneumon-fly*. Sphex, *ichneumon-waſp*. Veſpa. Apis. (*h*) Mutilla, *naked-bee*. (*i*) Chryſis.

(*k*) Diptera, from δυω two, and πτερὸν, a wing, are ſuch as have only two wings, and poiſers, as in the fly, fig. 6. (*l*) Oeſtrus, *gad-fly*. Muſca, *fly*. Tabanus, *whame*. Hippoboſca, *horſe-fly*.

little hills, horſes, cows, ſheep, ditches, dung-hills, and every offenſive object. Some (*m*) are found on all ſorts of flowers, particularly thoſe of a fœtid ſmell. Many (*n*) of theſe are moſt eaſily taken when they begin to feed; for in the middle of the day they are ſo quick and active, that it is almoſt impoſſible to catch them.

VII. The laſt great diviſion (*o*) contains ſcorpions, ſpiders, crabs, lobſters, *&c.* It is neceſſary only to obſerve here, that all kinds of inſects having no wings may be preſerved in ſpirits, brandy or rum, except crabs, lobſters, and the like, which may conveniently be preſerved dry.

Under each claſs of inſects, I ſhall relate the methods of killing them the moſt readily, and with the leaſt pain, as the purſuit of this part of natural hiſtory hath often been branded with cruelty; and however reaſonably the naturaliſt may exculpate himſelf by pleading the propriety of ſubmitting to an evil, which leads to uſeful diſcoveries, yet for wanton cruelty there never can be a juſt pretext.

> —The poor beetle that we tread upon,
> In corp'ral ſufferance finds a pang as great
> As when a giant dies (*p*).

I. The firſt claſs, conſiſting of beetles (coleoptera) are hard-winged. Many kinds fly about in the day, others in the evening, ſome at night only. They may be caught with a gauze net,

(*m*) Tipula. Conops. Aſilus, *waſp-fly*. (*n*) Bombylius, *flower-breeze*.

(*o*) APTERA, from ἀ, without, and πτερὸν a wing, inſects having no wings, as the ſpider, fig. 7.

(*p*) Shakeſpeare's Meaſure for Meaſure.

or

or a pair of forceps covered with gauze. When they are taken, ſtick a pin through the middle of one of the hard wings, and paſs it through the body, as in plate, fig. 1. They may be killed inſtantly, by immerſion in hot water, as well as in ſpirit of wine; then ſtick them on a piece of cork, and afterwards carefully place their legs in a creeping poſition, and let them continue expoſed to the air until all the moiſture is evaporated from their bodies. Beetles may alſo be preſerved in ſpirit of wine, brandy, or rum, cloſely corked up.

II. Inſects of the ſecond claſs (hemiptera) may be killed in the ſame manner as beetles, and likewiſe by means of a drop of the etherial oil of turpentine applied to the head; or in the manner to be deſcribed under the next claſs for killing moths.

III. The diviſion of butterflies and moths (lepidoptera) as well as all flies with thin membranaceous wings, ſhould be catched with a gauze net, or a pair of gauze forceps: when taken in the forceps, run a pin through the thorax or ſhoulders, between the fore-wings, as in plate, fig. 3. After this is done, take the pin by the head, and remove the forceps, and with the other hand pinch the breaſt of the inſect, and it will immediately die: the wings of butterflies ſhould be expanded, and kept ſo, by the preſſure of ſmall ſlips of paper, for a day or two. Moths expand their wings when at reſt, and they will naturally take that poſition.

The larger kinds of theſe inſects will not ſo readily expire by this method, as by ſticking them upon the bottom of a cork exactly fitted to the mouth of a bottle, into which a little

ſulphur had been put, and by gradually heating the bottle till an exhalation of the ſulphur takes place, when the inſect inſtantly dies, without injuring its colors or plumage.

The beſt method of having the moſt perfect butterflies, is to find out, if poſſible, the larva or caterpillar of each, by examining the plants, ſhrubs, or trees they uſually feed upon, or by beating the ſhrubs and trees with long poles, and thereby ſhaking the caterpillars into a ſheet ſpread underneath to receive them; to put them into boxes covered with thin canvas, gauze, or cat-gut, and to feed them with the freſh leaves of the tree or herb on which they are found; when they are full grown, they will go into the pupa, or chryſalis ſtate, and require then no other care, till they come out perfect butterflies, at which time they may be killed, as before directed. Sometimes theſe inſects may be found hanging to walls, pales, and branches of trees, in the chryſalis ſtate.

Moths might likewiſe be procured more perfect, by collecting the caterpillars, and breeding them in the ſame manner as butterflies. As the larvæ or caterpillars cannot be preſerved dry, nor very well kept in ſpirit, it would be ſatisfactory if exact drawings could be made of them while they are alive and perfect. It may be neceſſary to obſerve, that in breeding theſe kinds of inſects, ſome earth ſhould be put into the boxes, as likewiſe ſome rotten wood in the corners; becauſe, when the caterpillars change into the pupa, or chryſalis ſtate, ſome go into the earth, and continue under ground for many months before they come out into the moth ſtate; and ſome cover themſelves with a hard

ſhell,

ſhell, made up of ſmall pieces of rotten wood. Hence alſo, as many go into the earth, valuable inſects may ſometimes be found by digging after them a foot deep, about the roots of trees, ſhrubs, and plants.

IV. The fourth claſs of inſects (neuroptera) may be killed with ſpirit of wine, oil of turpentine, or by the fumes of ſulphur.

V. Thoſe of the next claſs (hymenoptera) may be killed in the ſame manner. A pin may be run through one of their wing-ſhells and body, as repreſented in plate, fig. 5.

VI. Inſects of the ſixth claſs (diptera) may likewiſe be killed by ſpirit, or by fumes of ſulphur.

VII. Thoſe of the laſt diviſion (aptera) are in general ſubjects which ſhould be kept in ſpirit.

When in ſearch of inſects, we ſhould have a box ſuitable to carry in the pocket, lined with cork at the bottom and top to ſtick them upon, until they are brought home. If this box be ſtrongly impregnated with camphor, the inſects ſoon become ſtupefied, and are thereby prevented from fluttering and injuring their plumage. Beſides a gauze forceps, the collector ſhould have a large muſqueto gauze net, made in the ſhape of a bat fowling-net, and alſo a pin-cuſhion with three or four different ſizes of pins, to ſuit the different ſizes of inſects.

In hot climates, inſects of every kind, but particularly the larger, are liable to be eaten by ants and other ſmall inſects, eſpecially before they are perfectly dry: to avoid this, the piece of cork on which our inſects are ſtuck in order to be dried, ſhould be ſuſpended from the cieling of a room, by means of a ſlender ſtring or thread;

thread; beſmear this thread with bird-lime, or ſome adheſive ſubſtance, to intercept the rapacious vermin of theſe climes in their paſſage along the thread.

After our inſects are properly dried, they may be placed in the cabinet or boxes where they are to remain: theſe boxes ſhould be kept dry; and alſo made to ſhut very cloſe, to prevent ſmall inſects from deſtroying them; the bottoms of the boxes ſhould be covered with pitch, or green wax, over which paper may be laid; or, which is better, lined with cork, well impregnated with a ſolution of corroſive ſublimate mercury, in a ſaturated ſolution of crude ſal-ammoniac in water, an ounce of which will diſſolve twenty ſcruples of the ſublimate.

The fineſt collections have been ruined by ſmall inſects, and it is impoſſible to have our cabinets too ſecure. Such inſects as are thus attacked may be fumigated with ſulphur, in the manner deſcribed for killing moths; if this prove ineffectual, they may be immerſed in ſpirit of wine, without much injuring their fine plumage or colors, and afterwards let them be ſprinkled about their bodies and inſertions of the wings with the ſolution above-mentioned. But baking the inſects in an oven in the manner to be deſcribed in the next ſection for birds, is the moſt effectual method of extirpating theſe enemies; however the utmoſt caution is requiſite in this proceſs, in regulating the heat of the oven.

Theſe obſervations and directions reſpecting inſects, may, perhaps, be the means of exciting the curioſity of ſome, whoſe enquiries after this part of natural hiſtory will be amply compenſated by the frequent opportunities of enlarging

their

their knowledge, as there is ſcarce any part of the ſurface of this globe, ſcarce a tree, a ſhrub, or a plant, an animal either living or dead, or even the excrements of animals, on which ſome kind of inſect does not depend for its ſubſiſtence and propagation.

———The flowery leaf
Wants not its ſoft inhabitants. Secure,
Within its winding citadel, the ſtone
Holds multitudes. But chief the foreſt-boughs,
That dance unnumber'd to the playful breeze,
The downy orchard, and the melting pulp
Of mellow fruit, the nameleſs nations feed
Of evaneſcent inſects. Where the pool
Stands mantled o'er with green, inviſible,
Amid the floating verdure, millions ſtray.
Each liquid too, whether it pierces, ſoothes,
Inflames, refreſhes, or exalts the taſte,
With various forms abounds. Nor is the ſtream
Of pureſt cryſtal, nor the lucid air,
Though one tranſparent vacancy it ſeems,
Void of their unſeen people——— (q).

(q) Thomſon's Seaſons, Summer, l. 296.

SECT.

SECT. II.

Method of preſerving BIRDS *and other Animals.*

——Vitam excoluere per Artes.
VIR. Æn. 6. v. 663.

THE general increaſe of knowledge of late in natural hiſtory, from the attention of individuals to various branches of it, muſt afford no ſmall degree of pleaſure to the ſenſible part of mankind. Whilſt ſuch different reſearches have given entertainment to different diſpoſitions, enlarged the mind, and engaged and diverted it from unprofitable or dangerous purſuits, they have occaſionally given riſe to the moſt uſeful improvements in every department of life, and afforded means of joining utility with elegance.

To promote theſe purpoſes more effectually, a more general knowledge of a good antiſeptic for animal ſubſtances has been much enquired after. Owing to a want of this, many curious animals, and birds particularly, come to our hands in a very imperfect ſtate: ſome from foreign parts entirely miſcarry, and others of the fineſt plumage are devoured by inſects.

Since the firſt inſertion of this account in the Gentleman's Magazine (*r*), the methods uſed by the ingenious captain Davis, and T. S.

(*r*) Vol. IX. 1770, page 293.

Kuckahn,

Kuckahn, have been publiſhed in the Piloſophical Tranſactions (*s*), of which I ſhall alſo avail myſelf, and add ſuch notes, as will convey an idea to the reader wherein theſe methods may be improved, and rendered more ſimple and familiar.

The former directs birds in perfect plumage, "to be opened from the upper part of the "breaſt to the vent, with a ſharp knife or "pair of ſciſſars, the feathers of the breaſt and "belly being firſt carefully laid aſide by the fin-"gers, ſo as not to hinder the ſkin being eaſily "come at. The ſkin muſt then be carefully "looſened from all the fleſhy parts of the breaſt, "body, thighs, and wings; after this, cut off "all the fleſh from thoſe parts, and take out "alſo the entrails and all the inſide: then, hav-"ing got a compoſition (*t*) of burnt alum, cam-"phor, and cinnamon, of each an equal quan-"tity, well powdered and mixt together, ſtrew "ſome of this powder lightly over the whole "carcaſe; but ſalt is by no means to be uſed "with this compoſition, as it always will drop "and naſty the plumage in moiſt weather; pour "alſo into the body a ſmall quantity of camphor "diſſolved in rectified ſpirits of wine (*v*); after "that, fill up the cavity with fine cotton, or "any ſoft woolly ſubſtance, pouring ſome of "the aforeſaid ſpirits into the cotton or ſtuffing. "Open next the mouth, and with a pair of ſciſ-

(*s*) Vol. IX. anno 1770, page 184, and 302. From the ſpecimens both theſe methods appear to ſucceed.

(*t*) For this compoſition I ſubſtitute Kuckahn's dry compound, altered in the manner hereafter to be mentioned.

(*v*) The application of ſpirit of wine and camphor, is always unneceſſary in preſerving theſe ſubjects.

"ſars

" ſars take away the tongue, the roof of the " mouth (*x*), eyes, brains (*y*), and inſide of the " head (*z*); fill that alſo with the ſame com- " poſition; and having procured eyes as near " the natural ones as poſſible, put them into " the ſockets by means of a ſmall pair of nip- " pers introduced at the mouth. The eyes will " be beſt made by letting fall ſome drops of " black ſealing wax on a card of the ſize of " the natural ones (*a*); the card muſt be cut " ſomething larger than the wax, to prevent " their falling out of the head. Fill the head " quite full with cotton, pouring ſome of the " ſpirits down the throat, with ſome of the " powder; a ſmall piece of braſs wire, that has " been heated in the fire to make it pliable, " may be put down the throat, being paſſed " through one of the noſtrils, and faſtened to " the breaſt bone, to place the head in any atti- " tude you chooſe; next fill up the body, where " the fleſh has been taken away, with cotton " and your compoſition; and having a fine

(*x*) To remove the roof of the mouth is both difficult and unneceſſary.

(*y*) In large birds the brains may be extracted by the eyes; the beſt inſtrument for this purpoſe, is a director uſed by ſurgeons, which may be had of an inſtrument maker at a trifling expence.

(*z*) Kuckahn directs the neck to be pulled within the ſkin, till the back of the ſkull is drawn in ſight, out of which a ſmall piece is to be cut, and the brains extracted; the cavity of the ſkull is then to be moiſtened with the varniſh, ſprinkled with the powder, and filled up with cotton, *&c.* and then the ſkin may be drawn back to its proper place; but this is troubleſome and injurious to the ſubject.

(*a*) Wax is not a proper ſubſtance for eyes; there are perſons in London, whoſe buſineſs it is to make glaſs eyes of any ſize or color, at a penny or two pence a pair.

" needle

" needle and ſilk, ſew up the ſkin, beginning " at the breaſt, obſerving, as you approach to- " wards the vent, to ſtuff the ſkin as tight as it " will bear. This will be eaſieſt accompliſhed " by means of a ſmall piece of ſtick or ivory, " like a ſkewer, till the whole is done: then lay " your feathers of the breaſt and belly in their " proper order, and your bird will be com- " pleated. If you would chuſe to put it into an " attitude, by introducing a ſmall piece of the " wire above-mentioned through the ſole of " each foot up the leg, and into the pinion of " each wing (*b*), it may be diſpoſed of as you " pleaſe."

Inſtead of uſing the ſolution of camphor in ſpirit of wine, Kuckahn recommends a liquid varniſh, made of two pounds of common or raw turpentine, one pound of camphor, and one pound of ſpirit of turpentine. The camphor is to be broke into very ſmall pieces, and the whole is to be put into a glaſs veſſel, open at top, which is to be placed in a ſand heat, till the ingredients are perfectly diſſolved (*c*).

For the dry compound of cinnamon, burnt alum, and camphor, directed in the foregoing

(*b*) Leman preſerved the attitude of his birds by a wire run ſideways through one wing into the breaſt bone, the other end of the wire being faſtened into the box incloſing the bird; inſtead of faſtening the ends of the wires to the pinions of the wings, after Captain Davis's method, I have always found it more convenient to faſten them to the breaſt bone; in either caſe this ſhould be done before the bird is ſewed up.

(*c*) This is a diſagreeble daubing compoſition, and is beſides unneceſſary, as well as any other liquid application.

method,

method, he ſubſtitutes the two following compoſitions.

Corroſive ſublimate, — —	$\frac{1}{4}$ lb.
Saltpetre prepared or burnt, —	$\frac{1}{2}$ lb.
Alum burnt, — —	$\frac{1}{4}$ lb.
Flowers of ſulphur, — —	$\frac{1}{2}$ lb.
Muſk (*d*), — — —	$\frac{1}{4}$ lb.
Black pepper, — — —	1 lb.
Tobacco ground coarſe. — —	1 lb.

Mix the whole together, and keep it in a glaſs veſſel ſtopped cloſe. Some of this is to be ſtrewed upon the inſide of the ſkin and cavity of the head, after they have been waſhed with the varniſh.

The other dry compoſition (*e*) is made of equal quantities of tanſy, wormwood, hops, and tobacco, which are to be cut ſmall and mixed together; with this the cavities of the craw and body are to be ſtuffed. He likewiſe directs an artificial breaſt to be made of ſoft wood, and

(*d*) The muſk renders this compoſition very expenſive, for which the ſame quantity of camphor might be ſubſtituted with real advantage; with this alteration, I make uſe of this powder, as cheaper than the compoſition recommended by Captain Davis, and equally effectual. Sir Car. a Linné recommends a compoſition of aloes, myrrh, and coloquintida. And Kramer mentions arſenic and burnt alum.

(*e*) This is entirely uſeleſs, and forms a leſs ſoft and ſmooth ſtuffing than cotton or tow, which on that account are preferable. The reader will obſerve the difficulty and expence of following this complex method recommended by Kuckahn; it is indeed ſurpriſing that his prolix directions ſhould be admitted at large into the Philoſophical Tranſactions.

fitted

fitted to the proper place, after being moiſtened with the varniſh (*f*).

In ſhort, after opening the bird by a longitudinal inciſion from the breaſt to the vent, diſſecting the fleſhy parts from the bones, and removing the entrails, eyes, brains and tongue, the cavities and inſide of the ſkin are to be ſprinkled with the powder; the eyes are then to be inſerted, and the head ſtuffed with cotton or tow; in the next place a wire is to be paſſed down the throat through one of the noſtrils, and fixed into the breaſt bone; wires are alſo to be introduced through the feet, up the legs and thighs, and inſerted into the ſame bone; next fill the body with cotton to its natural ſize, and ſew the ſkin over it; the attitude is laſtly to be attended to, and in whatever poſition the ſubject is placed to dry, that ſame will poſition will be retained afterwards (*g*).

When theſe antiſeptic powders before mentioned cannot be had, tobacco ſand mixed with a ſmall proportion of alum, black pepper, and camphor, may be ſubſtituted.

Small birds may be preſerved in brandy, rum, arrack, or firſt runnings; though in this manner the color of the plumage is liable to be extracted by the ſpirit.

Large ſea-fowl have thick, ſtrong ſkins, and ſuch may be ſkinned; the tail, claws, head, and

(*f*) It is almoſt impoſſible to proportion an artificial breaſt exactly of the natural ſize and ſhape; cotton or tow anſwers every purpoſe with leſs trouble; the varniſh I have before obſerved to be uſeleſs and inconvenient.

(*g*) The author's collection in natural hiſtory is always open for inſpection, and any information in his power may be commanded.

feet are carefully to be preſerved, and the plumage ſtained as little as poſſible with blood. The inſide of the ſkin may be ſtuffed as recommended above.

Kuckahn obſerves that "Baking is not only "uſeful in freſh preſervations, but will alſo be "of very great ſervice to old ones, deſtroy-"ing the eggs of inſects; and it ſhould be a "conſtant practice once in two or three years "to bake them over again, and to have the "caſes freſh waſhed with camphorated ſpirit, "or the ſublimate ſolution, which would not "only preſerve collections from decay much "longer, but alſo keep them ſweet (*b*)."

One of the beſt preſervatives, is to procure cloſe boxes, well glazed: with ſuch a precaution I have kept them in a dry room many years without the leaſt appearance of injury.—Baking is apt to crimp and injure the plumage; unleſs great care be uſed, and therefore the proper degree of heat ſhould be aſcertained by means of a feather, before ſuch ſubjects are baked.

When the ſubject is to be kept ſome time in a hot climate, it ſhould be ſecured in a box filled with tow, oakum, or tobacco, well ſprinkled with the ſublimate ſolution (Sect. I. p. 10.) The ſame preparations and precautions already deſcribed, are equally applicable to quadrupeds in general.

Small quadrupeds, all kinds of reptiles, as ſnakes, lizards, and frogs; fiſh (*i*) of all ſorts, and

(*b*) See Philoſophical Tranſactions, vol. LX. page 319.

(*i*) Sir Car. à Linné deſcribes another method of preſerving fiſh; this is to expoſe them to the air, and when they

and ſmall tortoiſes, with ſea eggs (*k*), and ſea ſtars, may be put into brandy, rum, arrack, or firſt runnings, with the addition of a little alum

Shells conſtitute an extenſive part of natural hiſtory, and may be collected in great plenty and variety on the ſhores of moſt iſlands and continents. Thoſe which are found with the fiſh in them, are the moſt valuable for the brightneſs of color, and ſmoothneſs of ſurface, as they loſe that beauty and poliſh, when they have been long expoſed to the ſun. In bivalves, or thoſe having double ſhells, as cockles, oyſters, *&c.* both the ſhells ſhould always be collected. It is ſufficient in packing up ſhells, to prevent

they acquire ſuch a degree of putrefaction, that the ſkin loſes its coheſion to the body of the fiſh, it may be ſlid off almoſt like a glove; the two ſides of this ſkin may then be dried upon paper like a plant, or one of the ſides may be filled with plaſter of Paris, to give the ſubject a due plumpneſs. Vid. Amæn. Acad. Vol. III. A fiſh may be prepared, after it has acquired this degree of putrefaction, by making a longitudinal inciſion on the belly, and carefully diſſecting the fleſhy parts from the ſkin, which are but ſlightly attached to it in conſequence of the putreſcency; the ſkin is then to be filled with cotton and the antiſeptic powder as directed for birds, and laſtly, to be ſewed up where the inciſion was made.

After this method of preparation I have juſt received a fiſh from the Weſt Indies; and the large collection in the Prince's cabinet at Bruſſels, there is reaſon to conclude was prepared in a ſimilar manner.

(*k*) The echini or ſea eggs, may alſo be dried; but they are then ſo liable to be broken, that the ſafeſt method is to preſerve them in ſpirit.

Horret capillis, ut marinus, aſperis,
Echinus. HOR. Epod. V. 27.

their rubbing againſt each other, which may be effected by means of paper, moſs, ſand, *&c.* Some of the ſhell fiſh may be preſerved in ſpirits, as this might prove an uſeful addition to the knowledge of this department of natural hiſtory.

The neſts and eggs of birds, would likewiſe contribute to increaſe the knowledge of natural hiſtory, and prove alſo highly ornamental amongſt collections in that branch of zoology.

SECT.

SECT. III.

Directions for bringing over SEEDS *and* PLANTS *from diſtant Countries.*

Nor ev'ry plant on ev'ry ſoil will grow;
The ſallow loves the watry ground, and low;
The marſhes, alders: Nature ſeems t' ordain
The rocky cliſt for the wild aſh's reign;
The baleful yeugh to northern blaſts aſſigns;
To ſhores the myrtles; and to mounts the vines (*l*).

EVERY part of the world has its peculiar productions; and in no objects of natural hiſtory is the variety more entertaining, than in the vegetable kingdom. The gardens of the curious have already been enriched with many valuable acquiſitions from diſtant countries; but many attempts alſo to introduce ſeveral other plants equally rare, have been unſucceſsfully made, owing to the bad ſtate of the ſeeds or plants when firſt procured, or the method of diſpoſing of them during long voyages, and ſuch accidents as the utmoſt precaution cannot prevent. The ingenious J. Ellis, F. R. S. has favoured the world with the moſt judicious obſervations on the preſent ſubject, which may

(*l*) Nec vero terræ ferre omnes omnia poſſunt.
Fluminibus ſalices, craſſiſque paludibus alni
Naſcuntur, ſteriles ſaxoſis montibus orni.
Littora myrtetis lætiſſima: denique apertos
Bacchus amat colles; aquilonem et frigora taxi.
VIRG. G. II. 109.

ſoon prove the means of many uſeful additions in horticulture to this kingdom; where

> Beds of all various herbs, for ever green,
> In beauteous order terminate the ſcene (*m*).

Ripe ſeeds ſhould be choſen for this purpoſe, which have been collected in dry weather, and kept dry without expoſing them to ſunſhine; and internally they ſhould be plump, white, and moiſt.

a. They may be preſerved by rolling each in a coat of yellow bees wax, about half an inch thick; and afterwards a number of theſe thus prepared, may be put into a chip box, which is to be filled with melted bees wax, not made too hot: the outſide of the box may then be waſhed with the ſublimate ſolution, (Sect. I. page 10.) and kept during the paſſage in a cool airy place. In this manner tea ſeeds, the ſtones of mangoes, and all hard nuts and leguminous ſeeds in general, may be prepared.

b. Inſtead of putting ſmall ſeeds in bees wax, they may be incloſed in paper or cotton which has been firſt ſteeped in melted bees wax, and then placed in layers in a chip box, which is to be filled as before with melted bees wax. Pulpy ſeeds, as thoſe of ſtrawberries, mulberries, arbutuſes, &c. may be ſqueezed together and dried, and then put into the the cerate paper or cotton above-mentioned.

c. The ſmall ſeeds well dried may be mixed with dry ſand, put into the cerate paper or cotton, and packed in glaſs bottles, which are to be well corked and covered with a bladder or leather. Theſe bottles may be put into a keg, box, or any other veſſel, filled with four parts

(*m*) Pope's Homer's Odyſſ. 7.

of

of common ſalt, two of ſaltpetre, and one part of ſal armoniac, in order to keep the ſeeds cool, and preſerve their vegetative power (*n*).

The following methods, which are attended with leſs trouble, have been alſo found ſucceſsful.

d. Seeds and nuts in their pods, may be encloſed in linen or writing paper, and put into caniſters, earthern jars, ſnuff boxes or glaſs bottles; the interſtices between the parcels of ſeeds ſhould be filled with whole rice, millet, panic, wheat bran, or ground Indian corn well dried. To prevent any injury from inſects, a little camphor, ſulphur or tobacco ſhould be put into the top of each caniſter or veſſel, and their covers well ſecured, to exclude the admiſſion of the external air.

e. The ſeeds well dried may be put into a box, not made too cloſe, upon alternate layers of moſs, in ſuch a manner as to admit the ſeeds to vegetate, or ſhoot their ſmall tendrils into the moſs. In the voyage, the box may be hung up at the roof of the cabin; and when the ſhip is arrived at the place of her deſtination, the ſeeds ſhould be put into pots of mold, with a little of the moſs alſo about them, on which they had lain.

Seeds preſerved after this manner, and alſo in the preceding (d), which are procured in the

(*n*) A method of preſerving ſeeds ſimilar to this, was firſt propoſed by the celebrated Linnæus, which he thus relates in a letter I had the honor of receiving from him. "Lagenula vitrea repleatur ſeminibus in Indiis nuper lectis et ſiccioribus, dein ſubere optime claudatur. Hæc indetur Lagenæ multo capaciori, et repleatur ſalibus variis mixtis, ita ut ſale undique lateribus, ſcilicet, fundo et orificio incarcetur interio Lagenula. Salibus mixtis oritur frigus majus, ne a calore climatis exſiccentur ſemina."

Eaſt Indies, may be examined when the ſhip arrives at St. Helena; and ſome of them which appear in a ſtate of vegetation, ſhould be ſown in caſes or tubs of earth kept as ſecure as poſſible from ſea water; ſome holes ſhould be cut in theſe caſes or tubs, and covered with baſt-mats or ſail-cloth, which will admit ſufficient air.

More of the ſame ſeeds may be alſo ſown after the ſhip has paſſed the tropic of Cancer, near the latitude of thirty degrees north. Plants or ſhrubs that are to be tranſported, muſt be taken out of the ground with a quantity of the ſoil covering the roots, which ſhould be wrapped in wet moſs, and ſurrounded with a baſt-mat, or dry plantain leaves, and put into the caſes or tubs, with the precautions above-mentioned.

In whatever method our ſeeds have been preſerved, it ſhould be a conſtant precaution to ſow them as ſoon as they have been expoſed to the external air, otherwiſe they probably will never vegetate.

In the firſt edition of this work, plaſter of Paris was recommended, as a proper ſubſtance for preſerving ſeeds in a ſtate of vegetation; this was tried upon acorns by the ingenious naturaliſt already refered to, and kept for three months (from January 11. to April 2. 1772.) When theſe acorns were examined, they were found dry, and as hard as horn. This ſubſtance therefore, as well as clay, is very improper for preſerving ſeeds, *&c.* as it abſorbs their moiſture, and thereby deſtroys their vegetative power (*o*).

(*o*) See alſo Philoſophical Tranſactions, Vol. 51. part 1. page 206.

When the naturaliſt is in ſearch of vegetable productions, different ſoils and ſituations ſhould be examined; as the ſea, and its ſhores, deep running waters, dikes, marſhes, moors, mountains, cultivated and barren fields, woods, rocks, *&c.* afford each their peculiar plants; and wherever any are collected, the particular ſoil and ſituation ſhould be remarked.

> From the moiſt meadow to the wither'd hill,
> Led by the breeze, the vivid verdure runs,
> And ſwells, and deepens, to the cheriſh'd eye (*p*).

Sometimes it may prove inconvenient to convey the plants which may be diſcovered, when it would not be ſo to ſend them dried in the form of a hortus-ſiccus. To do this in the beſt manner, and to make their ſtalks, leaves, *&c.* lie flat and ſmooth, they muſt be expoſed betwixt papers to a free dry air, with conſiderable preſſure upon them. The leaves and flowers ſhould be carefully expanded, for on this the beauty and value of the ſpecimen greatly depends. Thoſe plants ſhould alſo be gathered on a dry day, while they are in full bloom, and all their parts perfect and entire. When perfectly dry, they may be kept either looſe in quires of paper, or faſtened into a book, with glew made of fine iſinglaſs diſſolved in boiling water. Particular care is to be taken to avoid any injuries from moiſture, or inſects; to prevent any accident from the latter, let the paper and ſtalks of the plants be ſprinkled with the ſublimate ſolution, (Sect I. p. 10.)

The impreſſions of plants well taken off upon paper, look very little inferior to the beſt draw-

(*p*) Thomſon's Seaſons, Spring, l. 86.

ings,

ings, and may be done with very little trouble. For this purpoſe, ſome printer's ink (*q*), and a pair of printer's boſſes, ſuch as are uſed for laying the ink on types, are neceſſary. After rubbing theſe boſſes with a little of the ink, lay the plant betwixt them, and preſs it ſo as to give it ſufficient color; then take the plant and lay it carefully on a ſheet of paper, and preſs it with the hand, to give the impreſſion of the plant to the paper, which may be afterwards colored according to nature; a piece of blotting paper may be placed betwixt the plant and the hand, to prevent the latter from being dirtied by the ink.

But the moſt effectual method of ſending a branch of any plant with the flowers and parts of fructification entire and perfect, is to put them in bottles of brandy, rum, or arrack.

Corals, corallines, ſponges, *&c.* inhabitants of the ſea, are found in conſiderable variety near the coaſts of iſlands and continents, particularly in hot climates. Some of theſe are very tender and brittle when dry, and ſhould therefore be carefully packed up in ſand, in order to keep them ſteady, or placed betwixt papers in the manner of an hortus-ſiccus.

In hot climates, the inſects are very rapacious (*r*); and I have ſeen the fineſt fan-corals, and others of a ſoft texture when firſt taken out

(*q*) Where this cannot be procured, ivory, or lamp black, ground with boiled linſeed oil, may be ſubſtituted.

(*r*) It has been related, that the Spaniards after having ſettled on the north ſide of Jamaica, were obliged to quit it, on account of the rapaciouſneſs of the ants, which are ſaid to have killed their children by eating their eyes, when they were left in their cradles.—Sloane's nat. hiſt. of Jamaica, vol. I. introd. p. 48. et paſſim.

of

of the ſea, almoſt devoured by ants, before they became dry and hard. To prevent injuries of this kind, a little powdered corroſive ſublimate, or the ſublimate ſolution (Sect. I. page 10.) may be ſprinkled upon theſe productions. Some of the ſmall, and branches of the large ones, might alſo be put into ſpirits, and the parts of them thereby preſerved much more diſtinct, which would ſerve greatly to illuſtrate their natural hiſtory (*s*).

(*s*) Though the author agrees with the ingenious J. Ellis, F. R. S. in the propriety of ranking corals, corallines, &c. among the animal kingdom, he has placed them under this ſection, as they are uſually thought to be vegetable productions, and in their external appearance certainly reſemble them.

SECT.

SECT. IV.

Method of analyzing MEDICINAL WATERS (*t*).

Qui autem ad obſervandum adjicit animum, ei etiam, in rebus quæ vulgares videntur, multa obſervatu digna occurrunt.

BACON de Augment. Scient.

AS many ſprings contain a volatile principle, ſoon liable to be diſſipated, it is neceſſary to make our experiments on the ſpot, in order to diſcover the contents of ſuch waters. Various as theſe contents may at firſt appear, the apparatus proper to detect all of them may be reduced into a very ſmall compaſs.

When we purpoſe to examine any medicinal ſpring, the ſoil and face of the country ſhould be conſidered, the ſtony or mineral appearance, and particularly whether there are any mineral veins; the degree of heat of the water ſhould be aſcertained by a thermometer, and its comparative weight to other ſprings in the neighbourhood alſo carefully obſerved; after which we may enter on our experiments.

(*t*) Wallerius in his Hydrologia, Lewis in his notes on Neumann's chemiſtry, with Rutty, Lucas, Falconer, Monro, and other writers, have given directions upon this ſubject; but my friend Dr. Walker of Hull has treated it profeſſedly in his elegant Theſis de Aqua Sulphurea Harrowgatenſi, Edinb. 1770, dedicated to that learned Chemiſt and Philoſopher Dr. Black.

I. AERIAL MATTERS.

1. MEPHITIC, FIXABLE, OR FIXED *air*, is heavier than common, or vital air, and frequently mixed with water; by which union, common water is capable of diſſolving iron, and thereby forming a chalybeate ſpring, as in Pyrmont, Spa, and many other celebrated mineral waters (*v*).

This mephitic air is detected by lime-water, the former precipitating the calcareous earth of the latter in a white powder. To diſcover the quantity of this aërial matter, a bottle filled with the mineral water ſhould be tied over the mouth with a looſe bladder: the bottle is then to be placed in boiling water, the heat whereof will extricate the mephitic air, which riſing into the bladder, may be collected by tying the bladder cloſe to the neck of the bottle, and afterwards meaſured by a proportionable bulk of water. (See Sect. V.)

II. SALINE BODIES.

1. AN ACID is ſometimes found in the compoſition of mineral waters, which is always the vitriolic.

a. In its fixed ſtate, which is ſuppoſed to be ſeparated from pyrites: this is however very rare, and probably never occurs, as it cannot remain long in this ſtate, without being neutralized by earths, ſalts, or metals.

(*v*) This was noticed many years ago by Dr. Black in his lectures, and has ſince been adopted by ſeveral ingenious writers.

Many

Many of thoſe ſprings called acidulæ, received this name from the mephitic air we have already mentioned. If this acid be preſent, it may be diſcovered by an infuſion of ſyrup of violets, or by an infuſion of lacmus, or archil (*w*), which are turned of a brighter or reddiſh color by it. This acid may be detected alſo by a ſolution of lead in the nitrous acid; the ſolution ſhould be fully ſaturated. The nitrous acid uniting with calcareous earth, or foſſil alkali, falls in a white ſediment, while the vitriolic acid combines with the lead.

b. In its volatile ſulphureous ſtate. (See page 32.)

2. An ALKALI is alſo very ſeldom found in water in its proper ſtate.

a. When a *foſſil alkali* is preſent, it is more nicely detected by the ſyrup of violets, or infuſion of lacmus, than the former, theſe being turned green by the leaſt portion of alkali. If a conſiderable quantity of alkali were combined with the water, it might be precipitated by a ſolution of calcareous earth, or by acids.

b. A *volatile alkali* may be diſtinguiſhed by a ſolution of corroſive ſublimate mercury in water, or in the nitrous acid, the alkali rendering the ſolution white, a precipitation of a white powder enſues; but no change is produced, when the alkali is the fixed or foſſil, or if any, the mercury will be precipitated in an orange, brown,

(*w*) This is ſo nice a teſt, that even mephitic air is apt to give it rather a brighter color.

Since the firſt edition, Dr. Prieſtley makes a ſimilar obſervation on the authority of his correſpondent M. Bregman of Upſal. Philoſophical Tranſactions, Vol. LXII. 1773.

or

or reddiſh powder; where there is a conſiderable quantity of the volatile alkali, the water turns blue by the addition of copper. When this alkali is in a very ſmall proportion, ſome of the water ſhould be diſtilled over.

3. NEUTRAL SALTS are frequently found in medicinal waters.

a. GLAUBER'S SALT, compounded of vitriolic acid, and fixed foſſil alkali; ſpirit of wine added to a ſolution of this ſalt, precipitates it in a white powder; but no change is produced by the addition of any alkaline ſalt.

b. EPSOM SALT, formed of the ſame acid, and the earth of magneſia, is often a compoſition in purging waters. Any alkaline ſalt, either fixed or volatile, turns this water milky or curdly; the alkaline ſalt uniting with the vitriolic acid, precipitates the earth of magneſia.

c. NITRE, is compoſed of the nitrous acid, and fixed alkali. Water containing this ſalt ſhould be evaporated, and the nitre remaining may be known by deflagration, or by its making a crackling noiſe over the fire. When the nitrous acid is combined with calcareous earth inſtead of the fixed alkali, the earth may be precipitated by the addition of this alkali.

d. COMMON SALT, conſiſting of the muriatic acid, and foſſil alkaline ſalt. The acid of this ſalt is nicely detected by a ſolution of ſilver in the nitrous acid; the muriatic acid, having a nearer affinity with ſilver than the nitrous, unites with the ſilver, which falls down in a white ſediment, while the nitrous acid joins with the alkali of the common ſalt. It is proper to have a redundancy of the nitrous acid in the ſolution of

of ſilver, leſt the ſilver be precipitated by a calcareous earth, which may be in the water.

III. EARTHY SUBSTANCES.

a. CALCAREOUS EARTH, or calcined LIME-STONE, is found in moſt wells and medicinal ſprings; the preſence of which is beſt diſcovered by a ſolution of lead in the nitrous acid. This acid ſhould be ſaturated with as much lead as it will diſſolve, leſt the ſuperfluous acid ſhould ſaturate the earth, and prevent the precipitation of the lead. If there be any calcareous earth in the water, this ſolution turns it milky, and after ſome time a white powder is depoſited, the calcareous earth precipitating the lead, by uniting with the nitrous acid.

b. If calcareous earth be ſuſpended in water by combination with the vitriolic acid, gypſum, or ſelenites, is formed, which may be diſcovered by the addition of alkaline ſalt to this compound; the mixture ſhould be warmed a little, to promote the precipitation of the ſelenitic earth.

c. The ſame acid united with argillaceous earth, or earth of alum, produces an aluminous auſtere compoſition; and the earth may be precipitated alſo by alkaline ſalt, which uniting with the vitriolic acid, allows the earth to fall down in a ſediment.

IV. SULPHUREOUS.

SULPHUR may be ſuſpended in its proper form, though it is not ſoluble in this ſtate; but when the principle of inflammability in ſulphur

is

is combined with calcareous earth, or any alkali, in the form of an hepar ſulphuris, it readily diſſolves; in which caſe the water ſmells diſagreeably, like the ſcourings of a gun, or putrid eggs. It is diſtinguiſhed alſo by a ſolution of ſaccharum ſaturni (ſugar of lead) in the nitrous or vegetable acids; a little of this ſolution being marked in lines on paper, and the paper ſuſpended over the water, the volatile ſulphureous fumes ariſing from the water turn theſe lines of a brown or dark color; the inflammable matter of the ſulphur uniting with the lead in the ſolution of the ſaccharum ſaturni, partly revives the metal, and hence produces that dark color. (See Sect. V. page 39, 40.)

V. BITUMINOUS BODIES.

Bitumen frequently runs from amongſt rocks, whence it is called petroleum; it is alſo common in the bowels of the earth, as hath been often fatally experienced from thoſe bituminous vapours called fire-damps, which prove inflammable, and therefore differ from mephitic air, the latter extinguiſhing fire. Whether this inflammable vapour is formed of the principle of inflammability of ſulphur and the vitriolic acid in a volatile ſtate, is not ſo well aſcertained as the remarkable effects produced by theſe bituminous bodies in the mountains of Ætna, Veſuvius, and many others mentioned in hiſtory.

Liquid bitumen, naphtha, or petroleum, is never found combined with water, but floats on its ſurface in a manner evident to the eye, and may be particularly diſtinguiſhed by the taſte and ſmell.

VI. METALLIC SUBSTANCES.

a. IRON is a common ingredient in mineral waters, whence they are called chalybeate. The general method of diſtinguiſhing this metal, is by an infuſion or powder of galls, which turns water containing iron of a purple or black colour, deeper in proportion to the quantity of iron preſent.

But the moſt accurate method, is by means of the Pruſſian alkali (*x*) fully ſaturated with the inflammable matter of dried blood. This alkali mixed with a chalybeate water turns the latter immediately blue, and depoſits the iron in a powder of the ſame color.

b. COPPER in water is precipitated in a red powder by the ſame alkali.

c. ZINC is precipitated in a white powder by the Pruſſian alkali. Although this alkali precipitates all the metallic ſubſtances from acids, ſo that they may be diſtinguiſhed from one another, it does not any of the earths.

d. ARSENIC has been ſuſpected in ſome mineral ſprings, but I am acquainted with no proof of it. However, it may poſſibly happen that water running through arſenical veins, may carry off a quantity of arſenic. To diſcover this, the water

(*x*) The Pruſſian alkali is made of equal quantities of dried ox-blood, and fixed alkali. Theſe are to be burnt together in a crucible, and the aſhes diſſolved in a ſufficient quantity of water, when we enter on our experiments.

ſhould

ſhould be evaporated, and the reſiduum may be placed on a hot bar of iron, and if there be any arſenic, it is known by emitting a ſtrong garlick-like ſmell; or this reſiduum may be moiſtened with oil, and put between two bright plates of copper, which, when heated, are turned of a white color, if any arſenic be preſent; but the ſmell generally affords a ſufficient teſt.

SECT. V.

Experiments on the CONTENTS *of the* AIR.

C'eſt une erreur de croire, q'une experience aveugle, et une habitude mechanique, tiennent lieu de principes ſurs, et de maximes fondées ſur un ſolide raiſonnement.

BEECARIA Traduct. d'un diſcours ſur la Commerce.

NOTHING is more evident than that our atmoſphere abounds with a great variety of ſubſtances, if we conſider the various exhalations conſtantly emitted from all vegetables; in prodigious quantities from all animal bodies; and the great variety of foſſil matters that are inceſſantly riſing in the atmoſphere (*y*).

To inveſtigate the nature of all theſe is impoſſible; in very few caſes can we find the exhalation of one kind only; and many of them are of little conſequence; for if we conſider the quantity that is conſtantly exhaling, and the powers many of them might have in acting upon the human body, we ſhould expect the effects to appear every moment to a conſiderable degree, which we find very far from being the caſe: there are certainly ſome means by which they are obviated: theſe exhalations are no doubt more or leſs diffuſed into the higher regions of the air;

(*y*) This was publiſhed before the author became acquainted with the obſervations on different kinds of air by the learned Dr. Prieſtley, and as this inquiſitive philoſopher is ſtill purſuing his enquiries, it is thought ſufficient to refer the reader to the original experiments, in the laſt volume of the Philoſophical Tranſactions.

and

and probably alſo, from their mixture with one another, the moſt active come to be neutral and innocent.—

> Did not the acid vigor of the mine,
> Roll'd from ſo many thundring chimnies, tame
> The putrid ſteams that overſwarm the ſky;
> This cauſtic venom would perhaps corrode
> Thoſe tender cells that draw the vital air,
> In vain with all their unctuous rills bedew'd *.

It is in few inſtances that the exhalations are not expoſed to the means of mixture; and it is but ſeldom, comparatively, that effects are produced upon human bodies, although in a particular manner immerſed in this vitiated atmoſphere.

There are, however, ſome impregnations in the atmoſphere, which daily experience ſhews have conſiderable influence on our bodies; for though they may not ſenſibly affect the more robuſt and ſtrong, they certainly do the weak and delicate. With a view to inveſtigate them more particularly, the following experiments were made in the beginning of Auguſt, in the year 1769.

For ſome preceding weeks the air had been generally warm and dry, and moſtly free from wind; the evening on which I began to condenſe the atmoſpherical moiſture was calm, and clos'd a fine warm day; the place where this moiſture was collected, was in a court about the centre of Gracechurch-ſtreet.

I procured a large glaſs globe perfectly clean on the outſide, into which I put a quantity of ice

* Armſtrong's Art of preſerving Health, p. 51.

and ſal ammoniac powdered; the globe thus prepared, was ſuſpended in the air about five yards from the ſurface of the ground; the cold produced by the ice and neutral ſalt congealed the moiſture of the air on the external ſurface of the globe in the form of ice. This condenſed body was carefully ſcraped off with a ſilver ſpatula, and received into a wide-mouthed bottle well rinſed: when I had collected in this manner ſome ounces of condenſed matter, I proceeded on the following experiments.

EXPERIMENT I.

To know if it contained any fixed air, I put one ounce of the condenſed moiſture into a vial, the cork of which was perforated through the whole length, to admit the extricated air to paſs through: over the cork was tied a looſe bladder free from any air; I then placed the vial, thus prepared, in boiling water; the heat of the water extricating the fixed air from the condenſed moiſture, it eſcaped through the perforation of the cork into the bladder, where it was collected; the quantity of this air occupied a ſpace, which of ſimple diſtilled water was equal in bulk to 1 $\frac{1}{2}$ drachm. The vial, upon weighing it after the ſeparation of the air, was reduced a few grains lighter.

To be more certain that a great part of this extricated air was fixed, I applied it to lime-water; a precipitation of calcareous earth enſued, which convinced me of its preſence. (See Sect. IV. page 29.)

EXPE-

EXPERIMENT II.

I TOOK a quantity of the condenſed atmoſpherical moiſture, which had not been expoſed to heat; with this I mixed ſome ſyrup of violets diluted; the ſyrup evidently became of a greener color; which perſuaded me that no acid, but an alkali, predominated. (See Sect. IV. page 30.)

EXPERIMENT III.

BY mixing the condenſed moiſture with a ſolution of corroſive ſublimate mercury, the mixture became of a pale white, which proved the alkali to be volatile; for with a fixed alkali no change could have been produced; or, if any, the mercury would have been precipitated in a brown or reddiſh powder, called *mercurius precipitatus fuſcus Wortzii.* (See Sect. IV. page 30.)

EXPERIMENT IV.

A PIECE of paper marked with a ſolution of lead in diſtilled vinegar, was ſuſpended over a quantity of the condenſed moiſture, while in a ſtate of evaporation; but no change taking place in the lines marked on the paper, I concluded no ſulphur or inflammable matter was detached. (See Sect. IV. page 32.)

EXPERIMENT V.

THE condenſed moiſture evaporated to dryneſs, yielded a browniſh ſaline body, which from

ſome experiments (ſee Sect. IV. and VI.) appeared to be chiefly a compound ſalt of the vitriolic acid and volatile alkali, forming ſal vitriolatum ammoniacum; this I procured in the proportion of about 1 $\frac{1}{2}$ grain, in two ounces of the moiſture.

From what appears to be the contents of the city air, as above related, many particulars reſult, which may afford ſome inlight into the nature and cauſe of the different diſeaſes in the city from thoſe without. There is reaſon to preſume, that putrid effluvia are noxious to animal bodies; they may very often introduce a ferment into a ſubject diſpoſed to the putrefactive fermentation, and hence have a tendency to promote diſeaſes which ariſe from a putrid diatheſis.

But in populous cities, where prodigious quantities of theſe effluvia are daily generated, one might ſuſpect very fatal effects, fevers of the moſt dangerous kinds, more frequently to occur. It may be here ſuggeſted from the foregoing experiments, that a vitriolic acid is detached from the coals burnt in this city, which uniting with the volatile alkali from putrid matters, may form a compound in no reſpect injurious to the human machine.

There appears from Experiment I. a material circumſtance, which, until very lately, we were unacquainted with; we find that from all fermenting vegetables a fixed air is detached, which has ſometimes proved a ſudden poiſon to animals. The ſame air is generated from various ſources, being exhaled from the earth, as well as riſes from all breathing animals; and though a certain proportion of it when diffuſed

in

in the common or vital air ſeems conducive to health, yet when it becomes accumulated beyond this ſalutary proportion, it may injure what it was deſigned to preſerve (z); from which reflection the poet judiciouſly reſolves,

——Now from the town
Buried in ſmoke, and ſleep, and noiſome damps,
Oft let me wander o'er the dewy fields,
Where freſhneſs breathes, and daſh the trembling drops
From the bent buſh, as through the verdant maze
Of ſweet-briar hedges I purſue my walk;
Or taſte the ſmell of dairy; or aſcend
Some eminence,——
And ſee the country, far diffus'd around,
One boundleſs bluſh, one white-empurpled ſhower
Of mingled bloſſoms; where the raptur'd eye
Hurries from joy to joy—— (a).

Hence purer ſpirits through the blood diffus'd,
Give to the lip its ruby-tinctured hue:
Hence Health's gay ſmile illumes the dimpling cheek;
And the pulſe lightly dances, as the breaſt
Inhales, ſlow-heav'd, the pure refreſhing air (b).

(z) Upon this ſubject conſult Hales, Macbride, Pringle, Percival, Alexander, Cavendiſh, Lane, and particularly Prieſtley's ingenious experiments and obſervations on different kinds of air, firſt publiſhed in the Philoſophical Tranſactions in 1773. Vol. LXII. and ſince in a diſtinct treatiſe.

(a) Thomſon's Seaſons, Spring, l. 100.
(b) Ogilvie's Providence, l. 523.

SECT.

SECT. VI.

Directions for collecting and diſtinguiſhing Foſſil Subſtances, including Earths, Stones, Salts, Inflammables, and Metals.

TO write particularly upon theſe objects of natural hiſtory, is not the preſent deſign; a few general inſtructions may be ſufficient to direct a traveller in the choice of ſuch foſſil bodies as he may meet with. Wallerius, Woodward, Cronſtadt, Linnæus, Da Coſta, and Berkenhout, may ſupply an inquiſitive enquirer with more extenſive information.

Many are diſcouraged from purſuing this part of natural hiſtory, owing to the great variety of objects it comprehends, and the numerous properties by which they are diſtinguiſhed. But theſe when attended to, appear much leſs complicated, and capable of being reduced to a few ſimple heads; ſimple in their nature, and uniform in their compoſition; all new combinations producing chiefly a change only in form, color, and conſiſtence.

I. EARTHS and STONES in general.

Inſipid, not inflammable, preſerving their conſtitution in a ſtrong heat, and ſuch as are capable of fuſion become glaſs; the latter not ſoluble in pure water or oil.

A. EARTHS are bodies of no regular ſtructure, or determinate figure, inſipid, opake, diffuſible,

but not ſoluble in pure water, ductile while moiſt, not inflammable.

a. There are ſeveral kinds of molds which are principally diſtinguiſhed by their colors. Common mold, covers generally the ſurface of the globe; does not effervesce with acids, nor is it convertible into quicklime.

b. Clays, mixed with a quantity of water, form a ductile paſte; in the fire they harden.

Theſe are various in their conſiſtence and color, owing to their mixture with other bodies. Some, containing calcareous ſubſtances, effervesce with acids, which they do not when pure; and their variety in color is owing to the addition of iron, or other minerals. They are diſtinguiſhed into porcelain clay, potter's or pipe-clay, common clay, boles, ochres, fuller's earth, tripela or rotten ſtone, loam, &c.

c. Chalks and marles are frequently calcareous and effervesce with acids; whence they have been claſſed under calcareous ſtones; but as their conſiſtence is different, and their effects with acids various, they are here placed under the diviſion of earths (c).

B. Calcareous stones effervesce with, and are diſſolved by acids; convertible into quicklime by burning; and do not ſtrike fire with ſteel.

a. They appear under many different forms, and are found in ſtrata in the bowels of the earth, and frequently in large beds, as lime-ſtone, marble, &c.

b. Some ſtones, which in their ſtructure, appearance, and chemical properties reſemble

(c) Vide Da Coſta's Natural Hiſtory of Foſſils, page 63 and 75.

marble,

marble, may be included here, though they never form continued ſtrata, being found only in looſe independent maſſes, as the marmoroidæ, containing ſhells, corals, and other extraneous bodies, aſtroites or ſtar ſtones, ſea ſtars, entrochus, belemnites, cornu ammonis, or ſnake ſtone, &c. the remains of animals, which are conſequently of a calcareous nature (*d*).

c. Spars are calcareous bodies, found in mines, attendant on ores, &c. when pure, of a glaſſy appearance, and often cryſtalliſed into polygonal figures, as common ſpar, refracting ſpar, cryſtallized ſpar, ſtalactites, iſicle or dropſtone.

C. GYPSUM or GYPS; a calcareous ſubſtance, ſaturated with the vitriolic acid, and hence does not effervesce with acids; falls into a white powder when heated, and concretes again with water into a maſs, which ſoon hardens, called plaſter or ſtucco, as plaſter-ſtone, alabaſter, fibrous plaſter-ſtone or fibrous talc, gypſeous powder, ſelenites, &c.

D. TALCS do not ſtrike fire with ſteel, nor effervesce with acids; inſoluble in water, and very refractory in the fire *per ſe*, but fuſible with borax.

b. Micæ, glimmers or daze, have a ſcaly texture, the plates moſtly running horizontally parallel, eaſily ſeparable, of various colors, as

(*d*) The author does not attempt to give a complete ſyſtem of foſſils, but to comprize in as ſhort and as ſimple a view as poſſible the principal heads they comprehend, and he conceives theſe bodies may not improperly ſtand as above, without introducing ſeparate diviſions of petrifactions and incruſtations, the ſtony ſubſtances ſuſpended by the water being depoſited upon moſſes, roots, and branches of plants forming the latter.

green,

green, grey, red, brown, black, gold colored, ſilver mica, &c.

c. ASBESTOS and AMIANTHUS, are bodies very refractory in the fire. The former is the moſt flexible, and may be wove with the addition of hemp or lint into cloth, capable of enduring violent heat; the lint is indeed conſumed, but the aſbeſtos remains unchanged. Formerly dead bodies were wrapped in this kind of cloth, when they were thrown upon funeral piles, to prevent the aſhes of the deceaſed from mixing with the common aſhes.

E. STONE, a concreted granulated ſubſtance; breaking freely in any direction; effects with fire and acids various.

a. Of theſe there are divers kinds, as the quartzoſe ſand ſtone, free ſtone, Portland ſtone, Purbeck ſtone, Ketton ſtone, purple ſtone, Bath ſtone, &c.

b. Granite, vitrifiable, compoſed chiefly of quartz, mica, and felt ſpat (*e*), ſometimes of garnet, baſaltes and indurated ſteatites; ſo hard as to ſtrike fire with ſteel, and to receive a poliſh.

c. Conglutinated ſtones, compoſed of pebbles of various kinds, irregularly diſpoſed, and cemented by different ſubſtances, as pudding ſtone, mill ſtone, &c.

c. Porphyry, has a fine compact uniform texture like flint; in which detached pieces or ſeparate concretions of quartz are imbedded in all directions; ſtrikes fire with ſteel, is fuſible, but does not efferveſce with acids, as ophites, ſerpentine ſtone, and porphyries of different colors.

(*e*) Called by Da Coſta Rhombic Quartz.

F. Slate breaks invariably into laminæ or plates; opaque, not flexible; in general does not ſtrike fire with ſteel, though ſome of the red ſlates do; when written upon, the characters moſtly white; effects with acids and with fire, various.

There are many kinds of ſlate, as the black, green, purple, blue, red, brown, grey, ſhale baſs or ſhiver, plate ſlate, Iriſh ſlate, &c.

G. Fluor, is of a ſparry or cryſtalline appearance, does not ſtrike fire with ſteel, or effervesce with acids, vitreſcent *per ſe*; the moſt refractory is eaſily fuſible with borax or calcareous earths; being gradually heated it ſhines like phoſphorus, but its light vaniſhes before it becomes red hot; as the cryſtallized fluor, irregular fluor, cubic fluor, and zeolites.

H. Shirl, cockle or baſaltes, is a heavy hard ſtone; ſhoots into cryſtals of a priſmatical figure, moſtly of a black or green color.

I. Quartz, ſtrikes fire with ſteel, but does not effervesce with acids, nor fall to powder after burning. When pure cannot be melted *per ſe*, but with alkaline ſalts moſt readily into glaſs; texture ſolid, uniform; particles homogeneous, inviſible, impalpable, as,

a. Pure quartz, rock cryſtal, or quartz cryſtal, ſmoaky topaz, amethiſt, &c.

b. Cryſtals are diaphanous, hexagonal, columnar, pyramidal; ſome colorleſs, others milky, yellow, brown, red, purple or black; as corniſh diamonds, Briſtol ſtones, &c.

c. Flints, are ſemipellucid and detached; break in convex and concave poliſhed fragments, as the common flint, opal, onyx, Scotch pebble, carnelian, mocha-ſtone, chalcedony or white agate,

agate, ſardonyx, agate, cats-eye, &c. all of which decay by expoſure to air.

d. Jaſper is leſs hard than flint, and melts more readily into glaſs, but does not decay in the air. It is of a cryſtal baſis of various colors, and always opaque, as the heliotrope, the green, red, yellow, black jaſper, &c.

K. Gems are cryſtals of various colors, generally found in ſmall bodies, hard, bright and radiant, as the diamond, ruby, ſaphire, topaz, beryl or bluiſh green topaz, chryſolite or yellowiſh green topaz, emeral, garnet. From the difficulty of procuring theſe bodies, few experiments have hitherto been made upon them; the experiments on diamonds by Dr. Darcet, prove them to be volatile by heat.

II. SALTS.

SALTS are ſoluble in water, and recoverable by evaporation to their priſtine angular form; not inflammable nor ductile.

1. The ſimple ſalts are either alkaline or acid (*f*).

A. Alkaline salts turn the ſyrup of violets, or an infuſion of purple flowers, of a green color, and effervеſce with acid ſalts.

a. Foſſil alkali, ſo called from its being found in the earth, in large ſtrata, but in a compound ſtate. It is alſo in ſea ſalt, and may be pro-

(*f*) Some of theſe ſalts are not native productions; but as an acquaintance with theſe ſubſtances may prove an introduction to the knowledge of many uſeful chemical facts, a more general account is here given of them.

cured

cured from the aſhes of ſea weeds by burning. This ſalt is the *natrum* of the ancients.

b. Vegetable alkali, procured chiefly from the aſhes of land vegetables, whence are produced pearl aſhes, pot aſhes, *&c.*

c. Volatile alkali is diſtinguiſhed from the other two by its volatility, as it evaporates by heat before it becomes fluid. It is procured from putrid ſubſtances, particularly animal, and alſo from ſome ſubterraneous fires, the urine of animals, all horny and bony ſubſtances, and plentifully from ſoot.

B. MINERAL ACID SALTS turn the ſyrup of violets, or an infuſion of purple flowers, of a red color; they effervеſce with alkaline ſalts, and are only obtained in a fluid ſtate.

a. Vitriolic acid, or oil of vitriol, ſo called from vitriol or copperas, which contains this acid united with iron; is heavier than water, and colorleſs when pure. With the principle of inflammability it forms ſulphur, from whence this acid is chiefly procured.

b. Nitrous acid, or aqua fortis, is of an orange tawney color. Expoſed to the air, it emits fumes of a fiery color.

c. Muriatic acid, or ſpirit of ſea ſalt, is a colorleſs tranſparent fluid. Expoſed to the air, its fumes are white.

d. Acid of ſpar, is ſeparated from the fluor (Cronſtadt's Mineralogy, p. 109.) This newly diſcovered acid united with calcareous earth, forms the ſparry fluor, from whence it may be diſengaged by oil of vitriol, and the other mineral acids, which have a ſtronger affinity with calcareous earth. In ſmell and color the acid of ſpar reſembles the muriatic acid, but with

calcareous

calcareous earth, its common baſis, it forms a ſolid ſubſtance; whereas the muriatic acid, combined with the earth, remains fluid. Vide Forſter's tranſlation of Scheele's experiments.

C. Beſides theſe, we may enumerate,

a. Vinegar, or the acetous acid, which has the general properties of acid ſalts.

b. Tartar is a dry ſaline ſubſtance, neither fuſible nor volatile; ſuffers no change from heat under the boiling point, or 212°. It does not readily diſſolve in water, nor does it affect the ſyrup of violets ſo much as the preceding acids.

c. Sedative ſalt has the properties of ſalts in general. We are in great meaſure ignorant of its origin. It is chiefly procured from borax, a ſubſtance that is brought from the Eaſt Indies. Sedative ſalt is generally got in a cryſtallized form, reſembling ſnow, or bruiſed ſperma ceti.

2. NEUTRAL SALTS, or ſuch as conſiſt of an acid united with an alkaline ſalt, having the properties of ſalts in general. There are eighteen of theſe ſalts, which are enumerated in the following table, for which I am indebted to the learned Dr. Black of Edinburgh.

	Vitriolic acid.	Nitrous acid.	Muriatic acid.	Vinegar.	Tartar.	Sedative ſalt.
Foſſil alkali.	Glauber's ſalt.	Cubic nitre.	Common ſalt.		Rochelle ſalt.	Borax.
Vegetable alkali.	Vitriolated tartar.	Nitre.	Digeſtive ſalt.	Regenerated tartar.	Tartariſed tartar.	
Volatile alkali.	Vitriolat. ammoniac.	Nitrous ammoniac.	Sal ammoniac.	Vegetable ammoniac.		

In the foregoing table the acids and alkalies point reſpectively to the ſalts which they compoſe. Thus the nitrous compound ſalts are placed in the ſecond column, under the nitrous acid; and on the left ſide the particular alkali, with which each compound ſalt is combined, and ſo on of all the others.

Theſe neutral or compound ſalts may be decompoſed by the addition of an acid or alkaline ſalt; and their attractions are in proportion to the order ſet down in the table: thus if we want to ſeparate a volatile alkali from an acid, either of the fixed alkalies will anſwer. There is no line drawn between the foſſil and vegetable alkalies, becauſe their powers of attraction are nearly the ſame. The acid ſalts are likewiſe placed in the ſame order of attraction; the firſt column, or vitriolic acid, ſeparates the ſecond or nitrous acid; and this the third or muriatic acid, and ſo on of all the reſt.

3. METALLIC COMPOUND SALTS, metal diſſolved in the vitriolic acid.

a. Blue vitriol, vitriolic acid and copper.
b. Green vitriol, vitriolic acid and iron.
c. White vitriol, vitriolic acid and zinc.
d. Arſenic is found in a ſaline ſtate, being ſoluble in boiling water, yields a regulus by ſublimation with the principle of inflammability. Vide metals.

4. EARTHY SALTS, earth united with a mineral acid.

a. Rock alum, vitriolic acid and argillaceous earth.
b. Fixt ſal ammoniac, muriatic acid and calcareous earth.

c. Bitter

c. Bitter purging ſalt, or magneſia, glauber's ſalt, or Epſom ſalt, vitriolic acid and magneſia alba.

III. INFLAMMABLES.

THESE are not malleable or ductile; ſoluble in oils, but not in water, and readily take fire.

A. SULPHUR, formed of the vitriolic acid, united with the principle of inflammability, is found in all ores, except thoſe of tin, biſmuth, and cobalt. It is plentiful in ſtrata of coal, and is always diſcoverable from the ſmell it emits.

a. Mundic, or iron pyrites, is ſulphur mineralized with iron, and ſtrikes fire with ſteel.

b. Marcaſite, or copperas, ſtony ſulphur combined with copper, iron, &c. ſtrikes fire with ſteel.

c. United with earths, clays, and ſtones, ſometimes in regular cryſtalliſed figures; or in round or ſquare maſſes.

B. BITUMENS are either fluid or ſolid. Liquid bitumen iſſues out from crevices in mines, and takes fire by a candle.

a. NAPHTHA is a bituminous fluid, found floating on the ſurface of ſome waters, particularly in Perſia, from whence it is chiefly procured.

b. PETROLEUM, rock or foſſil oil, is thicker than the former, ouzes out of the crevices of rocks, whence it receives its name.

c. Pix judaica, or aſphaltum, is of the ſame nature, but hard.

d. Amber, and ambergris, are formed of the principle of inflammability with the muriatic acid. The former is found principally in Pruſſia. Ambergris is met with in the greateſt

quantities in the Eaſt Indies, at Madagaſcar, Mauritius, Borneo, the Molucca iſlands, and on the Egyptian coaſt.

e. Jet is compoſed of wood united with the principle of inflammability.

f. Coal, compoſed of argillaceous earth, vitriolic acid, and the principle of inflammability.

g. Turf, mold impregnated with bitumen, interwoven with vegetable roots.

IV. METALS.

The moſt ponderous of all mineral bodies; fuſible, but reſuming their original properties when cold, even after calcination by the addition of the principle of inflammability.

A. Gold, when pure, is not ſonorous, nineteen times heavier than water, ſoluble only in aqua regia, and hepar ſulphuris, unalterable by fire.

a. It is moſt frequently found pure, in its metallic ſtate, in thin plates, ſolid, cryſtalliſed, or in powder.

b. It is found in quartz, and in marcaſite, and ſometimes combined with iron, quickſilver, and a mixture of zinc and iron.

The largeſt quantities of gold are brought from the Brazils and the Spaniſh Weſt Indies. This metal is found alſo in Hungary, Tranſylvania, and in many other parts of Europe, in red, yellow, black, or iron-colored ſands. It is met with likewiſe in ſome rivers, as the Tagus, Ganges, Rhine, Saale, Niger, Danube, *&c.* called river, waſh-gold, or gold-duſt.

B. Silver, when pure, is eleven times heavier than water, ſoluble in the nitrous and vitriolic acids,

acids, but not in aqua regia; unalterable by fire.

a. It is often found native or pure, generally of about ſixteen carats ſtandard.

b. Minera argenti vitrea, or glaſs ſilver ore, of a dark color like lead ore, is ductile, and contains ſulphur.

c. Minera argenti cornea, or horn ore, reſembling reſin in color, and containing arſenic.

d. Minera argenti rubra, red ſilver ore, a brittle red-colored ore, containing arſenic and ſulphur.

e. Minera argenti alba, white ſilver ore combined with arſenic, antimony, ſulphur and copper, containing more copper than ſilver, of a light grey color, and of a dull ſteel-grained texture.

Silver is found in all countries, but moſt plentifully in America, particularly in Peru and Potoſi.

C. Copper, when pure, is near nine times heavier than water, the moſt ſonorous of all metals, diſſolves in all acids and alkaline ſolutions, oils and water. The leaſt quantity of this metal in ſolution, turns blue by the addition of volatile alkali; united with calamine it forms braſs; with tin, bell-metal.

a. Native or virgin copper, malleable, fibrous; generally found adhering to other foſſil ſubſtances.

Ziment copper, precipitated from the vitriolic acid; is granulated and friable.

b. Mountain-blue, "Copper united with calcareous earth, diſſolved and precipitated from an alkaline menſtruum." Lapis lazuli is reckoned

an ore of this metal, from which ultramarine is prepared.

c. Mountain-green, " Copper united with earth, diſſolved by an acid."

d. Glaſs copper ore, hard and brittle, uſually found with native copper, of a purple or brown color.

e. Grey copper ore, mineralized with ſulphur alone, ſoft ſo as to be cut by a knife.

f. Copper pyrites or mundic, yellowiſh or greeniſh; " Copper mineralized with iron, and frequently with a ſmall proportion of arſenic; marcaſitical." Shews the rainbow colors.

g. White copper pyrites, " mineralized with ſulphur, iron, and a conſiderable proportion of arſenic."

Copper ores are found in moſt countries, particularly in Sweden, Hungary, and Tranſylvania. Japan alſo affords a fine ſort of copper.

D. Iron is about eight times heavier than water, is attracted by one of its ores called the load-ſtone; ſoluble in all acids, alkaline ſolutions, water and air. Its ſolution is turned of a black or dark purple color, by galls and vegetable aſtringents.

a. In moſt clays and ochres, from which theſe earths and moſt precious ſtones receive their color. It may be even extracted from the aſhes of moſt animal and vegetable ſubſtances by burning.

b. Iron ochre, found in the fiſſures of iron mines, and at the bottom of chalybeate ſprings.

c. Blood ſtone, or ruddle, (Hæmatites) red, brown or grey, containing a large proportion of iron, but is not attracted by the magnet.

d. Chryſtalline

d. Chryſtalline ore, reſembles marcaſite, compoſed of ſhining cubical or octoedral particles, not attracted by the magnet.

e. Common iron ore, ſolid, brown or dark colored. Is attracted by the magnet.

f. Bluiſh ore, on the outſide generally brown, attracted by the magnet, and eaſily melts.

g. Magnet, loadſtone, or lapis lydius, mineralized with ſome ſulphur. Attracts iron, and points north and ſouth.

h. Emery, from σμαω, or σμεω, to cleanſe or poliſh, contains iron, ſometimes copper, and even gold or ſilver particles.

i. Marganeſe, is a blackiſh friable ore, not attracted by the magnet.

The ores of ſome other metals contain iron; the copper ores uſually contain more iron than copper; it is alſo found in chalybeate waters.

E. Tin is a ſilver-colored metal, ſeven times heavier than water, does not vitrify like lead, is malleable and unſonorous, ſoluble in aqua regia, vitriolic and muriatic acids.

a. Native tin, very rare.

b. Cryſtalliſed tin ore, tin cryſtal or tin grains; mineralized by an admixture of arſenical earth; found in cryſtalline maſſes, commonly of a poliſhed ſurface, of a blackiſh brown color.

c. Tin-ſtone, intermixed with a large proportion of arſenical earth and ſome iron.

d. Mineralized with iron; and alſo with ſulphur and iron, called black-lead.

Tin is found in England, Bohemia, Saxony, and in Malacca in the Eaſt Indies.

F. Lead is above eleven times heavier than water, unſonorous, malleable, and very fuſible, ſoluble in all acids and alkaline ſolutions.

a. Galena plumbi, potter's lead ore, or lead ore, or lead glance, mineralized with ſulphur, and a little ſilver, is a rich ore of lead, compoſed of flat planes, with cubic angles.

b. Antimoniated lead ore, or lead trail, mineralized with ſulphur and ſilver antimony, having irregular ſtriæ, or radiated lines.

c. Lead cryſtals, "Diaphanous, priſmatical or pyramidal, moſtly hexagonal," white, green, or yellow.

d. Lead ſpar, "White or grey, often yellowiſh, without the leaſt metallic appearance."

e. Lead ochre, or native ceruſſa. "A white powder ſometimes found on the ſurface of lead glance."

G. QUICKSILVER, or MERCURY, is a fluid metallic ſubſtance, fourteen times heavier than water, eaſily diviſible, and evaporates in a heat below ignition, or before it becomes red hot.

a. Sometimes it is found in a pure ſtate, called virgin mercury, but this happens very rarely.

b. It is chiefly procured in an ore united with ſulphur, called cinnabar, of a red color, and brittle; ſometimes combined with ſulphur and copper, of a dark grey color, and brittle glaſſy texture.

Cinnabar is found in Hungary, Tranſylvania, Carinthia, Bohemia, the Palatinate, France, Spain, Sweden, and probably in the Eaſt Indies and Japan.

H. ANTIMONY is the metallic mineral, and the metal ſeparated is called regulus of antimony; is a ſemi-metal of a ſilver color, conſiſting of brittle ſhining planes, above ſeven times heavier than water, ſoluble in aqua regia, and in ſpirit of ſalt.

a. Native,

a. Native, pure, or regulus of antimony.
b. Striated antimonial ore, mineralized with ſulphur, of a grey color.
c. Chryſtalliſed antimony, of a cryſtalline appearance.
d. Red antimonial ore, "mineralized with ſulphur and arſenic, ſtriated."

It is found in Bohemia, Saxony, Tranſylvania, Hungary, France, and other parts of Europe.

I. ZINC, or SPELTRE, is a bluiſh white ſemi-metal, ſeven times heavier than water, bears the ſtroke of the hammer longer than any other ſemi-metal; ſoon evaporates by heat. United with copper, it forms braſs.
a. Chryſtallized zinc, a pure calx of zinc, of a grey color, reſembling lead ſpar.
b. Mineralized of various colors, with ſulphur and iron, &c. as mock-lead, blend, black-jack, or mock-ore.
c. Calamine ſtone, or lapis calaminaris, a calx or earth of zinc united with a martial ochre. Tutty, pompholix, and nihil, are impure ſublimates or flowers of zinc, ariſing in the furnaces where zinc, or calamine, or compound metals made with them, are worked.

Zinc is found at Goſlar in Germany, and at Holywell, and other places in England. It is alſo brought from the Eaſt Indies, in a pure ſtate, called tutenague.

L. BISMUTH, or TIN-GLASS, is a ſemi-metal, of a white yellowiſh color, and laminated texture; above nine times heavier than water, and very fuſible, ſoluble in the mineral acids, and in aqua regia.

a. It is found plentifully in Saxony, and in leſs quantities in England, but it is ſcattered in arſenical ores very generally. It is diſtinguiſhed into native biſmuth, flowers of biſmuth, and biſmuth ore.

L. Cobalt is a ſemi-metal of a whitiſh grey color, fine grained texture, hard and brittle, about ſix times heavier than water; ſoluble in aqua regia, the vitriolic and nitrous acids, tingeing them red, after the diſſipation of the arſenic from the cobalt. By calcination, zaffre, and the blue glaſs called ſmalt, are procured.

a. Black cobalt, " mixt with iron without arſenic, friable, in form of an ochre or a ſlag, hard and gloſſy."

b. Cobalt ochre, or cobalt flowers, mixt with the calc of arſenic, an efflorеſcence on cobalt ores.

c. Cobalt ore, " mineralized with arſenic and iron, ſolid, reſembling ſteel, or cryſtalliſed.

d. Chryſtalline cobalt ore, " mineralized with ſulphur, iron and arſenic."

It is found moſt plentifully in Saxony, particularly in the diſtrict of Miſnia; but it is alſo met with in many other parts of Europe.

M. Arsenic, wherever it is found, may be known by evaporation over the fire, as it gives forth a ſtrong garlick-like ſmell, very noxious in a large quantity. (See Sect. IV. page 35.) ſoluble in acids, and even water by boiling.

a. Mineralized with ſulphur, called yellow, or red orpiment. Sometimes it is united with tin, lead, ſilver, copper, or antimony. The richeſt ſilver ores abound with arſenic.

b. White

b. White mundic, white pyrites or marcaſite, mineralized with ſulphur and iron.

Arſenic is found principally in the Bohemian and Saxon mines; but the richeſt native orpiment is brought from Turkey and Natolia.

N. PLATINA, PLATA SILVER, or PLATINA DE PINTO, introduced into England in the year 1749. Is eighteen times heavier than water, difficult of fuſion, and hardens moſt metals on mixture; reſembles ſilver in color. This metallic droſs or recrementum is ſaid to be found in the gold mines of the Spaniſh Weſt Indies. Vide Lewis's Philoſophical Commerce of Arts, Lehman's German Mineralogy, and Marcgraff's Opuſculas.

O. NICKEL is a ſemi-metal, which was firſt diſcovered about the middle of the preſent century *; is about 8 $\frac{1}{2}$ times heavier than water, of a coppery color. It is found united with iron, arſenic, ſulphur, and particularly with cobalt and biſmuth. Its ſolution in the nitrous and muriatic acids is green. The vitriolic acid has little or no effect upon it.

a. Copper-nickel, "mineralized with ſulphur, arſenic, and copper, reſembles copper."

In the preceding obſervations on foſſils, effervеſcence with acids, and ſtriking fire with ſteel, have often been mentioned: it would be neceſſary, therefore, for a traveller in ſearch of foſſil ſubſtances, to have with him a bottle of aqua fortis, or the nitrous acid, and a ſteel, to diſcover thereby on the ſpot certain properties

* This metal was diſcovered by Cronſtadt. See the Royal Academy of Sciences at Stockholm, for the years 1751 and 1754.

of

of ſuch bodies as may be collected. A hammer alſo may be neceſſary to break ſtones, *&c.* that are too bulky to bring away.

A blow-pipe is likewiſe an uſeful article; by blowing long and forcibly through ſuch an inſtrument, upon the flame of a candle, by which the point of the flame may be directed againſt the body to be examined, it will frequently diſcover whether it is a calcareous, vitrifiable, or refractory ſubſtance; and for greater preciſion, experiments for the ſame end may be afterwards made at the fire-ſide, on a charcoal fire, &c.

The collector ſhould alſo attend to as many of the following particulars as poſſible.

1. When any article is collected, mark it by a number, or ſome ſign of diſtinction, referring to a catalogue, with all the particulars that may be known relative to it; as,

2. Where it was found.

3. In what quantity, whether ſcarce or abundant.

4. If on the ſurface of the earth, or at what depth.

5. In what poſition, whether horizontal, perpendicular, *&c.* And with what other foſſil bodies it was found, as clay, ſtone, ſlate, mineral, *&c.*

6. Whether in ſtrata, or in looſe nodules.

7. The depth and thickneſs of the ſtrata, how they incline, or to what points of the compaſs they tend; or if level or horizontal; whether they have perpendicular or horizontal fiſſures, and what foſſil bodies are contained in theſe fiſſures.

8. All high mountains and hills, eſpecially their ſides, are to be ſearched; the ſhores alſo of

the

the ſea, with their banks, and the cliffs adjacent, and the falls of caſcades, rivers, and great gullies.

9. The ſituation of mines, pits, and quarries, whether in a valley or hill; and the diſpoſition of the ſtrata, whether horizontal, inclining, *&c.* their thickneſs, and the depth they lie, and what other foſſils are imbedded either in the ſtrata, or in the neighbouring caverns, fiſſures, partings, *&c.*

10. The waters of mines ſhould be examined, whether pure, taſteleſs, purgative, vitriolic, or chalybeate, *&c.*

11. The damps and ſteams of mines, and what are the conſequences or effects of them; in what ſeaſons and ſtate of the air they are chiefly obſerved; and what temperature the air bears in different depths of ſuch mines.

12. The account given by the natives, inhabitants, miners, workmen, *&c.* who may be acquainted with the ſubject.

SECT.

SECT. VII.

Directions for taking off IMPRESSIONS *or* CASTS *from* MEDALS *and* COINS.

———Et cætera penè gemelli.
HORAT. Ep. X.

CHIEFLY owing to the coſt required for purchaſing a cabinet of medals, it has happened that the ſtudy of them has hitherto been confined, comparatively, to a few individuals. Another principal impediment to the cultivation of an acquaintance with them, has ariſen from the difficulty of underſtanding the inſcriptions, for want of a ſufficient knowledge of languages; on which account in particular, this ſtudy has been condemned by the illiterate as barren and uſeleſs; but ſuch as are acquainted with the advantages which have already reſulted from thoſe *nummi memoriales*, cannot heſitate a moment to aſſiſt a promotion of a more general purſuit of the ſubject (*g*).

While Coloſſian ſtatues, and the hardeſt marbles, with their deepeſt inſcriptions, are deſtroyed by accidents, or by time, and paintings finiſhed with the higheſt colors quickly fade, a medal ſhall ſurvive innumerable accidents, and diſcloſe hiſtorical facts a thouſand years after ſtatues are crumbled away; and when nothing but the names of an Apelles or a Praxiteles remain. Does not a ſingle medal, of

(*g*) Though the ſtudy of medals does not properly belong to natural hiſtory, this ſhort account of taking impreſſions from them, may prove acceptable to ſome travellers.

which

which we are in poſſeſſion, give us greater light into hiſtory, than the once famous libraries of Alexandria and Pergamus, which are now no more? From theſe, and many other conſiderations, I would willingly contribute my endeavours to render this ſtudy more general, and conſequently more uſeful. I have tried a variety of methods to enable a young medaliſt to collect a cabinet, which may initiate him into the knowledge of medals and coins at a trifling expence.

The method of taking off plaſter of Paris and ſulphur impreſſions, is known to every body: the firſt is too ſoft to preſerve them from injury, and the brittleneſs of ſulphur is a greater objection.

I found by forming a coat or layer of thin metal over the plaſter of Paris, it would be a conſiderable defence. Tin is the cheapeſt and moſt convenient metal for the purpoſe, as it is ſufficiently flexible, and at the ſame time very much reſembles ſilver. The tin-foil I have tried, is of the ſame kind with that uſed for ſilvering looking-glaſſes. It ſhould be laid over the medal or coin intended to be taken off, and then rubbed either with a bruſh, the point of a ſkewer, or a pin, till it has received perfectly the impreſſion of the medal; the tin-foil ſhould now be pared off round the edge of the medal, till it is brought to the ſame circumference: the medal muſt then be reverſed, and the tin-foil will drop off into a chip box or mould ready to receive it, the concave ſide of the foil, or that which is laid on the face of the medal, being uppermoſt; upon this pour plaſter of Paris made in the uſual manner, and when dry, the figure may be taken out

of

of the box or mould, with the tin-foil ſticking on the plaſter, the convex-ſide being now uppermoſt again, in which poſition it is to be kept in the cabinet, after it becomes dry. To have an impreſſion very perfect, the thinneſt tin-foil ſhould be made uſe of (*h*).

The impreſſions taken in the foregoing manner almoſt equal ſilver medals in beauty, and are very durable: if the box or mould (*i*) be rather larger than the impreſſion of tin-foil, the plaſter, when poured on, runs round its edges, and forms a kind of white frame, or circular border, round the foil, whence the new-made medal appears more neat and beautiful. If this tin-foil be gilt with gold-leaf, by means of thin iſinglaſs glue, or boiled linſeed oil, the medal will reſemble gold.

(*h*) This method does not in the leaſt injure any medal or coin.

(*i*) Chip boxes, uſed by apothecaries, anſwer this purpoſe, and may be eaſily procured. A ſlip of paper wrapped round any circular body with a flat ſurface, is equally convenient.

THE NATURALIST'S AND TRAVELLER'S COMPANION.

PART the Second.

ALTHOUGH it may be admitted with peculiar honor to the preſent age, that the knowledge of natural hiſtory and of ſcience in general has been of late conſiderably enlarged; yet as the objects of human enquiry are numberleſs, and frequently diſperſed in diſtant parts of the globe, as well as complicated in their hiſtory, the ſentiments of an ancient philoſopher may be adopted even at this day with propriety; "Multa etenim ſunt "quæ eſſe audivimus, qualia autem ſint igno- "remus! Quamque multa venientis ævi popu- "lus, ignota nobis, ſciet (*a*)!"

At the ſame time if we reflect upon the foregoing ſuggeſtion, reſpecting the amazing progreſs made in natural hiſtory within the ſpace of a few years, we may find ſufficient induce-

(*a*) Seneca.

ment to perſevere in purſuits ſo worthy of a rational mind.

It would render natural hiſtory much more pleaſing, as well as greatly tend to its progreſs, were the limits of our knowledge therein preciſely aſcertained, that travellers and curious perſons, who have little leiſure for reading, might not only be informed of what is already diſcovered, but alſo of what is ſtill doubted, or unknown; by which means their inquiries would be better directed, and more conducive to real information and uſeful diſcovery.

From theſe conſiderations, I imagined that the following queries and obſervations would tend to promote the original deſign of this publication; which, though a work of conſiderable labor and attention, is ſubmitted with due deference to the candour of the public. If the experience of the author, or the information of his friends, ſhould hereafter afford him a more extenſive and intimate acquaintance with the ſubjects recommended, he would retract a miſtake with as much readineſs as he would communicate any future diſcovery.

SECT.

SECT. I.

Obſervations and Queries reſpecting Learning, Antiquities, Religious Rites, polite Arts, &c.

Ingenuous arts, where they an entrance find,
Soften the manners, and ſubdue the mind *.

1. THE alphabets of the various nations, their pronunciation and numeric value, with their numeric figures, if different from the letters of the alphabet, and books written in each language, eſpecially grammars, dictionaries, &c. with the dates of each when written, merit the inveſtigation of the curious; likewiſe the materials uſed for writing, and their preparation, as the methods of making ink, paper, and pens, and of ſizing and glewing the paper; the art of printing, and the contrivances for doing it.

2. Manuſcripts, in good preſervation, of the Hebrew bible, or parts thereof, particularly if upwards of 300 years old.

3. Books containing the religious principles of any nation or people, and which uſually are written in a dialect different from that which ſuch people now ſpeak, or in a poetical, high metaphorical ſtyle, and therefore underſtood by few only, and for the moſt part kept very ſecret; amongſt theſe we may enumerate the Chartah Bhade Shaitah of Bramah, the Chartah

* ———Ingenuas didiciſſe fideliter artes
Emollit mores, nec ſinit eſſe feros.
OVID. Pont.

Bhade and Aughtorrah Bhade Shaſtah, the Vedam (*b*), the ſacred books of the Perſees, written in the ancient Perſian dialects, called the Zend, and Pehlvi (*c*); the Koran of Mahomet; the ſacred books of the Mendæans or Sabaites, at or near Baſſora in the Perſian gulph; the voluminous ſacred books of the Lamas in Nexpal and Thibet called Khangiur, and its myſtic part termed Riuté; the ſacred books of the prieſts in Pegu and Siam, and others of ſimilar tendency. Theſe would be ſtill more valuable, could Engliſh, Latin, or French tranſlations be added.

4. Deſcriptions of the manners, cuſtoms, feaſts, and religious ceremonies of the reſpective nations; the architecture both exterior and interior of their temples, religious, public and private buildings; the figures, names, genealogies and ranks of their divinities and idols; their ſacred and domeſtic utenſils, the caſts and ranks of people, the learning and religious tenets of each nation, to all which explanatory drawings would be required. What nations uſe circumciſion, and what are the advantages derived from ſuch a cuſtom, or diſadvantages from the omiſſion of it? Is circumciſion ever extended to the females, and in what manner is it employed?

5. The tranſlations of the bible in different languages; and the ſacred books of Chriſtians of various denominations, as the Georgian, Ar-

(*b*) In the peninſula on this ſide the Ganges, the ſacred books of the Bramins are contained in the Vedam, copies of which in the original Sancrit character, would be very valuable.

(*c*) The Pehlvi is a more modern dialect.

menian,

menian, Perſian, Æthiopian, Coptic, Arabic, and Syriac, eſpecially among the Chriſtians on the Malabar coaſt, and in the iſle of Socatora (*d*).

6. The hiſtory and ſucceſſion of princes, the origin and migration of nations; the government and political conſtitution of each country; the cauſes of the increaſe or decay of power.

7. A relation of the private and domeſtic life of the people; the cuſtoms obſerved at the birth of children; the marriages, ſepulchral rites, and any other circumſtances characterizing each nation.

8. An account of the aſtronomy and chronology of different nations, whether they obſerve the ſyſtem of the ſeven days of the week, the names for theſe days, with their ſignification. The number, names, and ſignifications of their months; the number of theſe in a year; whether they are uſed to conciliate the moon's and ſun's motion by any intercalation, or a certain cyclus of years; the names for particular ſtars and conſtellations in the zodiac, with their ſignifications; the diſtinctions of the other ſtars from the planets, with the length of their revolutions.

The ſtate in which the art of drawing, carving, and engraving in ſtones has been, or now is. Specimens, drawings, or collections of old inſcriptions, engravings, ſeals, gems, ſtatues, carvings, baſſo and alto relievos, and the places where each of the above monuments are found, the ſize, ſubſtance whereon it is worked, &c. the ancient and current coin, with the exact valuation.

(*d*) The Neſtorian Chriſtians formerly had a ſettlement among the Indians on the Malabar coaſt, and were there very much reſpected. Are ſome of theſe ſtill exiſting? Have they any ancient Syriac books?

SECT. II.

Commerce, Manufactures, Arts, Trade, &c.

JOVE has the realms of earth in vain
Divided by th' inhabitable main :
If ſhips profane, with fearleſs pride,
Bound o'er the inviolable tide (*e*).

FRANCIS.

DEſcriptions and drawings, of the looms, tools, machines, &c. employed in manufactures, particularly if ſimple, ingenious, and gaining time or ſtrongly increaſing power, might prove highly beneficial.

2. An account of the planting, gardening and agriculture of each country; the manure uſed, the time and labor employed in each branch of buſineſs; the price of labor, the implements of agriculture; the kinds and quantities of corn ſown in an acre, the quantities reaped in different ſoils; the proportion of vineyards or paſture lands to arable, and the number of people in a ſquare mile of paſture, arable lands, vineyards, or any other kind of plantation.

3. The kinds of pigments, ſtains, and dying materials known and uſed, particularly in China; are they mineral or vegetable? the manner

(*e*) Nequicquam Deus abſcidit
Prudens oceano diſſociabile
Terras, ſi tamen impiæ
Non tangenda rates tranſiliunt vada.
HOR. l. 1. Od. 3.

of

of preparing and applying them, with the advantages and diſadvantages of each ſort compared with ours; particularly the materials, machines and methods employed by the Indians for dying, ſtaining and printing their chintzes, callicoes, &c.

4. The wood and timber uſed for ſhip building; the form and conſtruction of the ſhips; the wood employed for maſts; the ſuccedanea for oakum, ropes, cables, ſails, pullies, &c. with the comparative advantages and diſadvantages.

5. The means devized for catching quadrupeds, birds, fiſhes, ſhells, &c. either for food, or to prevent the increaſe of ſuch as are noxious to the people or their plantations; are any animals made tame and employed to catch others, or are any methods uſed for killing or inebriating them?

6. The materials of cloathing; if animal ſkins, the manner of dreſſing them; if the hair of animals, or the threads of certain inſects, the method of ſpinning, twiſting and weaving ſuch ſubſtances; if vegetables, how are they cultivated, dreſſed, ſpun and manufactured? The cut and make of the dreſſes in general, with the advantages and diſadvantages of each particular part.

7. The various objects of commerce in general, the growth and manufacture of each article, with the names by which it is known, and its uſes when deſigned only for inland trade; the price of labor, and the number of people employed in each department.

8. It is a common opinion, that large quantities of remnants and rags of all kinds of ſcarlet cloth, are yearly carried from England to China, and that the Chineſe extract from them their fine red pigments. If this be true, what methods are employed to extract the color?

9. It has been obſerved that analogous ſubſtances are moſt proper for dying homogenous bodies (*f*); thus animal ſubſtances are beſt for dying wool and ſilk, becauſe wool and ſilk are animal ſubſtances. A blue dye, made of woad (Iſatis of Linnæus) is found to be full of inſects. Is it not the ſame caſe with indigo? Are not all the laſting dyes made from animal ſubſtances, or of ſuch as contain numerous inſects?

10. The manner in which the beſt indigo is manufactured in the interior parts of Indoſtan, and the plant from which it is made. Is it from the Indigofera or the Anil? Are there any rules to aſcertain when the plant has ſoaked ſufficiently, and how long it ought to be beaten?

11. Is there any linnen made of flax or hemp, or what other ſubſtances are ſpun and wove in India beſides cotton? What uſe is made of the yellow or brown cotton taken from the Bombax? Is it manufactured for apparel, and appropriated for a certain order of men, as prieſts or Bramins?

12. Deſcriptions and drawings of the inſtruments and machines employed by the Chineſe and Indians to clean the cotton from the ſeeds.

13. Is only European zaffer from cobalt uſed by the Chineſe for painting their porcelain

(*f*) Vid. hiſtoire de l'academie, an. 1768. art. 11.

blue,

blue, or have they ſome of their own? If they have, what name is it known by, and how is it manufactured? It is probably finer than ours, from the richneſs of the old China figures.

14. The preparation of the pickle or catchup called Soya; is it made from the Dolichos Soya Linn.? Is ſalt, wheat or barley added, and in what proportions?

SECT.

SECT. III.

Metereological Obſervations, Food, Way of Living, Animal Oeconomy in general, &c.

For every man to native cuſtom prone,
Conforms and models life to that alone.
GOLDSMITH.

IT is always ſatisfactory to have regular meteorological accounts by the aſſiſtance of a good barometer and thermometer; and to obſerve at the ſame time the quarter the wind blows from, and its degree or violence; the quantity of rain and ſnow by inches; the ſize of hailſtones; the appearance of aëreal phenomena, as auroræ boreales or northern lights, fiery globes, halos or bright circles round the ſun and moon; with the effects likewiſe of thunder ſtorms, lightening, &c.

2. The traveller ſhould alſo remark the ſucceſſion of ſeaſons, and the various fruits and productions of each country; the times of ſowing or planting, as well as of harveſt, or of reaping the grain, &c. the budding or flowering of trees, or ſhrubs. The food of the inhabitants, and the preparation of it previous to its uſe.

3. Some account might be collected of the general prevailing diſeaſes in different ſeaſons, and the cauſes producing the ſame, or the remedies employed for curing them, and the methods in which ſuch remedies are adminiſtered.

4. Are

4. Are any diſeaſes cauſed by the effluvia of certain trees or plants, or is the touching, handling or cutting of trees or plants ever ſuddenly prejudicial to health? Does the effluvia from ſpice trees or the frankincenſe tree prove deleterious?

5. What are the effects or ſymptoms, which ariſe from the bite of poiſonous ſnakes, or any reptile or inſect? Has the bite of a ſnake ever been found to have a ſalutary effect in curing a certain previous diſeaſe, or does the bite of one ſnake, ever deſtroy the effects of another? Are there any counterpoiſons or antidotes uſual againſt the bite of ſnakes? Is muſk or any ſpecies of the ariſtolochias a remedy which the ſnakes avoid and fly from, or do any of theſe prove lethal to ſnakes?

6. Is the pedra de cobra uſed as an antidote againſt the effects of the bite of any ſnake, and with what ſucceſs? How is this remedy procured and applied?

7. The manner of managing domeſtic animals, whether in health or otherwiſe. The animals which the natives in any country caſtrate, and the effects produced by it; as well as the period when ſuch a cuſtom was firſt introduced.

8. It would deſerve remarking where and in what manner Polygamy is introduced, whether perpetual or temporary, and the effects of it upon the manners, religious or civil cuſtoms, population, &c. of ſuch countries. Does Polygamy prevent ſome men from procuring wives, or are the women brought from neighbouring nations? Is it any where cuſtomary for one woman to be married to ſeveral huſbands during the life of the firſt?

9. Accu-

9. Accurate calculations of births or burials in provinces or towns, and the proportions of males to females, would prove very valuable.

10. Have any buildings or ſhips furniſhed with electrical rods after Dr. Franklin's method, ever received any injury from lightening?

11. Is the venereal diſeaſe cured without mercury? and if ſo, by what remedies?

12. What diſeaſes attack the workmen employed in different kinds of manufactories?

SECT.

SECT. IV.

Zoology.

Non ad unam natura formam opus ſuum præſtat; ſed in ipſa varietate ſe jactat.

SENECA Quæſt.

1. IT would greatly tend to improve our knowledge in this department of natural hiſtory, were the following remarks reſpecting quadrupeds to be carefully made; viz. the general times of coupling, and of geſtation; how many young are brought forth at a time, and how often during one ſeaſon; at what period of life they become prolific or barren; where their principal reſort and dens are; whether the males aſſiſt the dams in providing food for the young of the carnivorous tribe; how long theſe are under the protection of the old ones; and what age each ſpecies attains.

2. It might be enquired whether any perſon hath ever ſeen elephants in copulation, which has been hitherto denied; it is ſaid that if the wild elephants perceive any body, they immediately begin to rave, and ceaſe not till the curioſity of that perſon has been rewarded with death; and though the Indian princes have kept great numbers of tame elephants of both ſexes, they never could procure a breed from them. What differences are there betwixt the African and Indian elephants? Is the ſtructure of the grinding teeth equal or flat in all, or have ſome elevated or pointed crowns, ſimilar to thoſe of carnivorous animals? Do elephants ever ſhed their tuſks or teeth, or are they permanent?

3. How

3. How many ſpecies of tygers ſo called, or more properly of leopards, panthers, ounces, &c. are there in India, and what are the ſtated and perpetual marks for diſtinguiſhing each, in different periods of life? What other animals of the feline kind are found in India, with the ſpecific characters of each?

4. Does the ſhakal or jackal (Canis aureus Lin.) bear any reſemblance to an animal commonly called the croſs-fox (Pennant's Syn. Quadr.) What animal do the Arabian writers call banat-el-auvi?

5. Are armadilloes (Daſypodes Lin.) in Aſia or Africa, in what parts, and which are their characteriſtics?

6. There are many ſpecies of the jerboa (Mus jaculus Lin.) and probably if they were known, a ſeparate genus might be formed: an animal as big as a greyhound, weighing about eighty pounds, and hopping on two legs, was diſcovered on New Holland by Drs. Banks and Solander; it would prove a conſiderable acquiſition in natural hiſtory to learn the characteriſtic of this genus, the number and diſpoſition of the teeth, the ſpecies, general œconomy and manner of living, of theſe animals.

5. When the various ſpecies of the feathered tribe begin to couple or pair ſhould be noticed; when, where, and of what materials each bird builds its neſt, with the color, ſize and number of eggs; how long the eggs are in incubation; what the young are fed with, and at what periods are they fledged; with the diſtinctions between male and female birds in different ſeaſons and ages.

6. The

6. The migration of birds ſhould not be diſregarded, but their merely diſappearing in one part of the country is not properly a migration, for we frequently find that birds ſhift their place of abode, at certain ſeaſons, on account of ſome palatable food, which may be more plentiful in one part than in another; the croſſing wide ſeas, or extenſive continents is underſtood. If any bird be found out at ſea, the ſpecies of bird, the direction of its flight, the diſtance from land, and the latitude and longitude ſhould be noted.

> ———In figure wedge their way,
> Intelligent of ſeaſons; and ſet forth
> Their airy caravan, high over ſeas
> Flying, and over lands; with mutual wing
> Eaſing their flight: So ſteers the prudent crane
> Her annual voyage, borne on winds: The air
> Floats as they paſs, fann'd with unnumber'd plumes (*g*).

In northern climates, it would be uſeful to obſerve when ſwallows are firſt ſeen, and when they diſappear; and likewiſe in what climates they have been found, whether in a torpid or active ſtate, with the ſpecies and peculiar characters.

7. What birds are allowed a privilege or immunity from being injured or killed? and what may be the reaſons for the ſame, or the advantages derived therefrom?

8. Some birds of prey are employed in the eaſt by the Grandees in hawking and hunting. What means are uſed for teaching ſuch birds, and what are their differences, ſize, figure, plumage, names, ſpecific characters, &c?

(*g*) MILTON.

9. What are the character, plumage, food and œconomy of the Indian ravens (Buceros Lin.)

10. Are there any humming birds (Trochilus Lin.) in the Indies or China with a filiform long tongue conſiſting of two ſemicylinders?

11. What are the peculiar diſtinctions of the true wild peacock? Are there any white peacocks in India, and of a ſeparate ſpecies? Is the change in plumage obvious in wild peacocks, or is this the reſult of domeſtication? Do white peacocks breed with grey and green ones, and what is the color of the young breed?

12. Where is the Hirundo eſculenta, Linn. found, and of what ſubſtance is the neſt compoſed, which is ſo much in requeſt with the Chineſe and Europeans? Is it made from ſome molluſcæ or ſeaworms, as Kæmpfer ſays; or from fiſh ſpawn, as M. le Poivre author of the Travelling Philoſopher affirms; or from ſea weeds, agreeable to what Dalrymple relates? Where is the neſt fixed, and what is the ſpecific character of this ſpecies of bird?

13. Is there to be found in the Indian ſeas a Jaculator fiſh, Sciæna Jaculatrix (*b*), different from the Chætodon roſtratus, Linn? or is the faculty of ſhooting at inſects with a drop of water peculiar to theſe fiſh, or common to any others?

14. Has the Raja Torpedo, Linn. or the cramp or numb-fiſh, the ſame electric qualities as the Gymnotus electricus?

15. As there is not yet one good figure of the ſea cow (Trichechus Manatus Lin.) it

(*b*) Philoſophical Tranſactions, Vol. 54. and Vol. 56. t. 8. p. 186.

would

would be deſirable to procure a good drawing of it while alive, to have it diſſected, and to obſerve wherein it coincides with, or differs from other animals nearly related to it, as the ſeal, dolphin, &c.

16. The ſeaſons ſhould be noticed, when different ſpecies of fiſh ſpawn, and the rivers, bays, ſhoals, or ſands they reſort to for that purpoſe; what age they attain before they ſpawn, the food they eat, the age they live to as accurately as poſſible, the ſize they acquire, and the latitude wherein they are generally found; the method of catching them, and to what uſes alſo they are applied when caught, and whether they are eſteemed wholeſome food or the contrary.

17. Which ſpecies of moth or butterfly is it, the caterpillar of which in China affords that ſtrong grey kind of ſilk, and how is it manufactured or wore? How are theſe ſilkworms or caterpillars preſerved, fed and managed? The introduction of ſuch a new ſilk into England would be a uſeful acquiſition, and redeem entomology from the cenſure it is now branded with, of being a mere curioſity void of any real utility.

18. Are the inſects which are ſaid to collect the Lac or Gummi Lacca from the Croton lacciferum, Linn. bees, ants or waſps? Are they wild, or domeſtic, and the property of certain perſons? and how are they managed and propagated? Vid. ſect. V. 18.

19. Are there any rattle-ſnakes in the Indies or China, or in any part of the world beſides America?

20. The various bundles of ſwimming ſea weeds ought not to be neglected; for beſides the different kinds of fuci they conſiſt of, they generally contain ſmall crabs, ſhrimps, or other ſubmarine inſects or worms, ſuch as the oniſci, monoculi, ſometimes ſhells and eſcharæ, ſertulariæ, and other corallines.

21. The various animals inhabiting ſhells deſerve inveſtigation, as there are probably new genera yet to be diſcovered: It is not fully aſcertained whether the inhabitant of the paper-nautilus be an animal really belonging to that ſhell, or only uſes it in the ſame manner as ſome crabs do other ſhells; neither is it known whether or no the paper-nautilus animal, or the ſepia, increaſes or enlarges its ſhell. Indeed the generation, and general œconomy of all the molluſca claſs is very imperfectly known.

22. Experiments might be tried to aſcertain whether pearls are not ſuch concretions in the ſhells wherein they are found, as the crabſtones (Lapides ſeu oculi Cancrorum) in the ſhells of the river cray-fiſh, which collect alkaline or calcareous materials from the food of the animal for the formation of the new ſhell, as do the Mya and Mytilus margaritifer a new layer for the increaſe of their ſhells. Do the ſhells containing the pearls gradually increaſe through the year, or at a certain ſeaſon only?

23. It ſhould be carefully remarked which of the ſhells, eſpecially of the Murex and Turbo kinds, afford a red or purple juice fit for ſtaining or dying like the purple of the ancients; whether the dye be permanent, and the method of preparing and applying it by ſome Indian nations. D'Ulloa, in his South-American voy-

age,

age, Vol. I. page 182. ſpeaks of one of theſe ſhells found near Panama on the Darien Iſthmus; and Janus Plancus, or Giovanni Bianchi, in his work on ſhells, mentions the Turbo ſcalaris Lin. or Wendeltrap, as affording the violet purple of the Romans.

24. Deſcriptions and drawings of the animals or polypes inhabiting the various corals, coral-lines, ſponges, Echini or ſea-eggs, Aſteriæ or ſtar fiſh, Sepiæ or cuttle fiſh, Holothuriæ or ſea nettles, and all the various molluſca, and the polypes of the Tubipores, Madrepores, Millepores, Cellepores, &c. deſerve the attention of a natural hiſtorian, as but few of them are well deſcribed or known.

SECT. V.

Botany.

Itaque iſta quoque naturæ rerum contemplatio, quamvis non faciat medicum, aptiorem tamen medicinæ reddit.

CELSUS.

1. THE ſeeds of almoſt all the Indian plants are worth collecting, they may be preſerved in the manner preſcribed in ſect. III.

2. What trees bear the Myrobalans, a drug formerly much in requeſt, but at preſent in little eſteem as a medicine, but which might probably afford ſome uſe in dyeing? What ſpecies of trees bear the Myrobalans bellirica, chebula, citrina, and indica or nigra; whether a kind of Phyllanthus as the Myrobalanus emblica? The uſe alſo of the ſame in India?

3. Is the aloe-wood or Eagle-wood, the Calambac, and the Agallochus, the ſame or different? The place from whence procured, with the generic and ſpecific characters?

4. Is the Orchel or Rochel (Lichen roccella, Lin.) which is found in Madeira, and uſed to dye red, a kind of Lichen or a Zoophyte? Is the ſteeping it in putrid urine ſufficient to prepare it?

5. Where does the Lignum Rhodium grow? Is it a kind of Nyctanthes or Indian Jaſmine?

6. Of what genus and ſpecies is the Tea-wood, of which tea cheſts are made?

7. What is the wood Tek on the Malabar coaſt, of which the Indian ſhips are built? Is it a fact

a fact that it never is attacked by ſea worms (Teredo, Lin.)?

8. The various kinds of pulſe, as peaſe, beans, phaſeoli, &c. eſpecially ſuch as are reared at the Cape of Good Hope, and exported to the Indies; the other fruits likewiſe which are cultivated at the Cape, and taken in as refreſhments on board the European ſhips.

9. The various plants in the gardens of the Dutch Eaſt India company, with the methods of cultivating them, are worthy to be noticed; and the indigenous ſhould be diſtinguiſhed from thoſe imported and naturalized; whether there are Clove, Nutmeg and Cinnamon trees, with their height, leaves, and general characters; and what ſpecies of tree is the Muſcadine of the Indies, cultivated at the Cape.

10. The different kinds of Palm trees, their nature, ſoil, characters, names given by the natives, and the uſes they put them to, or their fruits, leaves, bark, pulp, &c.

11. To what genus and ſpecies does the graſs called Tatack belong? and where does it grow, beſides Madagaſcar, Java, the Malay Iſlands, and the French Iſle de Bourbon? The graſſes in general which thrive in particular countries and climates, with the ſoil and culture, and the kinds of cattle moſt addicted to each.

12. What plant bears the famous Indian nut, which is uſed as a reſtorative, and is immenſely dear, being ſold according to ſome at three thouſand pounds apiece; the place where it is cultivated, the ſoil it requires, and its real or imaginary virtues?

13. The Columbo root called by the Portugueſe Raiz de Mozambique, is a native of the

continent of Aſia, but it has been tranſplanted to Columbo in Ceylon, and the Dutch now ſupply all Aſia with it. Is it different from the root of Lopez or Lopezia; and if ſo, what are the characters of each?

14. A deſcription of the ſmall grains and Phaſeoli, with which the Indians on the Coromandel coaſt ſow their fields after the rice harveſt, with the minutiæ of their cultivation, eſpecially the machines employed for watering the grounds.

15. A tree or plant in Cochin China called Tſai, on being fermented like Indico, plentifully furniſhes a green colored flour, which in dyeing gives a laſting tincture of a fine emerald; it would be therefore worth enquiring after the method of extracting the color, and the additional ſubſtances employed in fixing it, and what ſtuffs are beſt fitted to receive the ſame.

16. Are the ſtamina of the Pterocarpus Draco, Lin. which is called Draco arbor ſiliquoſa populi folio, by Commelin, and Lingoum by Rumph. Amb. 2. t. 70. connected or ſeparate?

17. Which genus of plants does the true Ebony belong to? Is it an Aſpalathus?

18. Is the Croton lacciferum, of which certain inſects are ſaid to make or extract the Lac or Gummi Lacca, found in China or Coromandel; and do the inſects really employ the plant for this purpoſe? Vid. ſect. IV. 18.

19. Many varieties of Rice are found in India, as the Red with red huſks; the little Rice ſmall grained, oblong and tranſparent; the great long Rice with round grains; the dry Rice which grows beſt on a dry ſoil, and requires

quires no watering; and the common Rice; are theſe various kinds of Rice different ſpecies or varieties only? The culture, characters, and ſpecimens of each, if different, would be neceſſary.

21. There is an elaſtic gum, called Borrachio in Portugueſe, and Kaoutchuck in the language of the natives near Cayenne in South America, of which it is ſaid the Chineſe make elaſtic rings for laſcivious purpoſes, but here uſed by ſurgeons for injecting liquids, and by painters for rubbing out black-lead-pencil marks. Is this gum manufactured in India or China, and from what plant, and in what manner, with the different uſes it may be applied to? Is the plant an Euphorbia or Apocynum?

22. What plants produce Gum Myrrh and Gum Ammoniac, and how are they collected?

23. What plant affords the Gummi rubrum aſtringens from Gambia?

SECT. VI.

Mineralogy.

And join both profit and delight in one *.
CREECH.

1. THE manner of working mines, and the methods employed in getting, breaking and extracting the ores; the tools and machines employed for each of theſe purpoſes, are ſubjects worthy of enquiry. Is gunpowder ever uſed to blaſt the ſtones or ores? The manner in which the ore or metal is found under ground, whether in perpendicular veins, or in vicinity to them; in horizontal flat ſtrata, looſe pieces, or in ſolid continued bodies; in what kind of ſtone, and at what depth; the means of carrying off the water when preſent in the mines. The vapors found in them, whether mephitic and noxious, or inflammable when fire or light comes in contact with them.

2. The manner in which white copper, reſembling ſilver, is manufactured, and the various proceſſes whereby it is done.

3. The operations uſed in extracting the metals from the reſpective ores, with ſpecimens and names of the ores, and the places where they are procured; the products yielded from the ores by fuſion; the fluxes added to promote fuſion, or the ſubſtances to prevent volatilization, and whatever is ſubſervient towards

* Simul et jucunda et idonea dicere vitæ.
HOR.

refining

refining of metals or reguluſes; with the ſtructure and materials of the ovens, the fuel and quantities of it employed, the time for each operation, and the preparatory cautions, including the picking, pounding, waſhing, ſifting, and uſtulating of the ores; and drawings of the various machines and tools uſed for each purpoſe.

4. The places from whence the various gems or precious ſtones are procured, with their prices on the ſpot; the ground and ſtrata wherein they are found, and the figure or form of each kind before being cut, whether determinate and general, or accidental.

5. The manner of manufacturing thoſe immenſe quantities of ſalt-petre annually exported from the Eaſt Indies; the ſoil employed for the lixivium, and the manner of preparing the ſoil. Are any animal or inflammable ſubſtances added to it? By what means is lixivium precipitated? Is an alkali uſed for that purpoſe, and how is the alkali procured? Is any uſe made of the remainder of the lixivium after the precipitation of the ſaltpetre? Is the lixivium boiled, and inſpiſſated by fire for the cryſtalliſation, or by the heat of the ſun?

6. If borax be artificial, in what manner and from what ſubſtances is it made? If native, in what ſtrata and ſoil does it lie in?

7. How far has the knowledge, value, and uſe of metals extended amongſt nations?

THE END.

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